Allen-Bradley

EtherNet/IP Modules in Logix5000 Control Systems

Catalog Numbers 1756-ENBT,
1756-EN2T, 1788-ENBT, 1769-L32E,
1768-ENBT, 1734-AENT,
1794-AENT, 20-COMM-E,
22-COMM-E

User Manual

Rockwell Automation

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://literature.rockwellautomation.com) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING ⚠	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
ATTENTION ⚠	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence
SHOCK HAZARD ⚡	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
BURN HAZARD ♨	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

Introduction

This release of this document contains new and updated information. To find new and updated information, look for change bars, as shown next to this paragraph.

Updated Information

The document contains the following changes.

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About the 1756-EN2T Module	15
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Interlocking and Data Transfer between Controllers

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Send Email

About This Publication

This manual describes how you can use EtherNet/IP modules with your Logix5000 controller. With this manual, you can learn how to communicate between your controller and various devices on the Ethernet network.

Who Should Use This Publication

You should use this manual if you program applications that use Ethernet with one of the following Logix5000 controllers:

- CompactLogix controller
- ControlLogix controller
- FlexLogix controller

You should also:

- have a basic understanding of networking concepts.
- have a basic familiarity with the following software:
  - RSLogix 5000 software
  - RSLinx Classic software

Additional Resources

This table lists documentation that may be valuable as you program your application.

Catalog Number	Title	Publication Number
1734-AENT	POINT I/O Ethernet Adapter Installation Instructions	1734-IN590
	POINT I/O Ethernet Adapter User Manual	1734-UM011
	Point I/O EtherNet/IP Adapter Release Notes	1734-RN002
	POINT I/O Selection Guide	1734-SG001
1756-ENBT	1756 10/100Mbps EtherNet/IP Bridge, Twisted Pair Media Release Notes	1756-RN602
	1756-ENBT ControlLogix EtherNet/IP Product Profile	1756-PP004
	ControlLogix EtherNet/IP Bridge Module Installation Instructions	1756-IN019
	ControlLogix EtherNet/IP Communication Release Notes	1756-RN591
	ControlLogix Redundancy System Revision 11 Release Notes	1756-RN582
	ControlLogix Redundancy System Revision 13 Release Notes	1756-RN608
	ControlLogix Redundancy System Revision 15 User Manual	1756-UM523
1756-EN2T	ControlLogix EtherNet/IP Bridge Module, Firmware 1.2 Release Note	1756-RN631
	ControlLogix EtherNet/IP Bridge Module Installation Instructions	1756-IN603

Catalog Number	Title	Publication Number
1756-EWEB	1756-EWEB EtherNet/IP Web Server Module Release Notes	1756-RN604
	ControlLogix Redundancy System Revision 13 Release Notes	1756-RN608
	ControlLogix Redundancy System Revision 15 Release Notes	1756-RN628
	ControlLogix Redundancy System User Manual	1756-UM523
	EtherNet/IP Web Server Module Installation Instructions	1756-IN588
	EtherNet/IP Web Server Module User Manual	ENET-UM527
1768-ENBT	CompactLogix EtherNet/IP Communication Module Installation Instructions	1768-IN002
	CompactLogix EtherNet/IP Communication Module Release Notes	1768-RN001
1768-L43	1768 CompactLogix Controllers User Manual	1768-UM001
	1768 CompactLogix Selection Guide	1768-SG001
	1768-L43 CompactLogix Controller Installation Instructions	1768-IN004
	CompactLogix L43 Controller Version 15 Firmware Release Note	1768-RN015
1769-L32E and 1769-L35E	CompactLogix Controller Installation Instructions	1769-IN020
	CompactLogix Controller Revision 13 Release Notes	1769-RN008
	CompactLogix Controllers V15 Firmware Release Note	1769-RN015
	CompactLogix Performance and Capacity Quick Reference	IASIMP-QR007
	CompactLogix Selection Guide	1769-SG001
	CompactLogix System User Manual	1769-UM011
1769-L32E	CompactLogix & SCADA Popular Configuration Drawing	IASIMP-QR001
		IASIMP-QR002
1769-L35E	CompactLogix Controller Revision 12 Release Notes	1769-RN006
1769-SDN	Compact I/O 1769-SDN DeviceNet Scanner Module Release Notes	1769-RN007
	Compact I/O 1769-SDN DeviceNet Scanner Module User Manual	1769-UM009
	Compact I/O DeviceNet Scanner Module Installation Instructions	1769-IN060
1769-SDN, 1788-DNBO and 1788-EN2DN	DeviceNet Modules in Logix5000 Control Systems User Manual	DNET-UM004
1788-DNBO	DeviceNet Daughtercard Installation Instructions	1788-IN053
	DeviceNet Daughtercard Release Notes	1788-RN006
1788-ENBT	EtherNet I/P Communication Daughtercard Release Notes	1788-RN527
	EtherNet/IP Daughtercard Installation Instructions	1788-IN054
1788-EN2DN	EtherNet/IP to DeviceNet Linking Device Release Notes	1788-RN528
	EtherNet/IP-to-DeviceNet Linking Device	1788-IN055

Catalog Number	Title	Publication Number
1734-AENT	Point I/O EtherNet/IP Adapter Installation Instructions	1734-IN590
	Point I/O EtherNet/IP Adapter User Manual	1734-UM011
	Point I/O EtherNet/IP Adapter Release Notes	1734-RN002
1794-AENT	FLEX I/O EtherNet/IP Adapter Module Installation Instructions	1794-IN082
	Flex I/O EtherNet/IP Adapter Module Release Notes	1794-RN059
20-COMM-E	PowerFlex EtherNet/IP Adapter User Manual	20COMM-UM010
22-COMM-E	PowerFlex EtherNet/IP Adapter User Manual	22COMM-UM004
Networks Series	NetLinx Selection Guide	NETS-SG001

To view or download these publications, go to:

http://www.literature.rockwellautomation.com

To obtain a hard copy, contact your Rockwell Automation distributor or sales representative.

Notes:

Start

Introduction

The Logix5000 family offers several EtherNet/IP communication modules. Select a module based on the EtherNet/IP functions the application requires.

EtherNet/IP Module	Works With a Controller to Originate Communication (Scanner/Bridge)	Interfaces With Distributed I/O Modules (Adapter) or End Node
1756-ENBT	X	X
1756-EN2T	X	X
1756-EWEB	X	
1769-L32E, 1769-L35E	X	
1768-ENBT	X	
1788-ENBT	X	
1794-AENT		X
1734-AENT		X
2*x*-COMM-E		X

The EtherNet/IP communication modules:

- support messaging, produced/consumed tags, and distributed I/O.
- encapsulate messages within standard TCP/UDP/IP protocol.
- share a common application layer with ControlNet and DeviceNet protocols.
- interface via RJ45, category 5, unshielded, twisted-pair cable.
- support half/full duplex 10 Mbps or 100 Mbps operation.
- require no network scheduling.
- require no routing tables.

This chapter introduces these modules and describes how you can use them in a control system.

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About the 1756-ENBT Module	15
About the 1756-EN2T Module	15
About the 1769-L32E and 1769-L35E Modules	16
About the 1768-ENBT Module	16
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About Bridging Across Networks	18

The remaining chapters in this publication describe how to configure and program the EtherNet/IP communication modules. A listing of catalog numbers at the beginning of each chapter identifies the modules that support the feature described in that chapter.

Additional Resources

For more information on these products, see Additional Resources on page 9.

About the 1756-ENBT Module
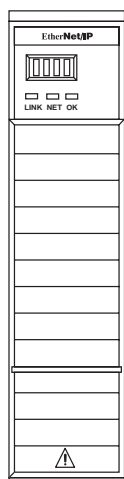
The 1756-ENBT module operates either as an interface for a ControlLogix controller to communicate with other devices over an EtherNet/IP network or as an adapter for 1756 I/O modules on an EtherNet/IP network. This module supports:

- control of I/O.
- communication via produced/consumed tags and MSG instructions.
- communication with HMI.
- configuration and programming, such as uploading and downloading.
- an adapter for 1756 I/O modules.
- a web server to provide diagnostic and status information.

IMPORTANT	If you use various 1756 EtherNet/IP communication modules, for example a 1756-ENBT with a 1756-EN2T, in the same chassis, do not use the rack-optimized communication format. If you must use the rack-optimized communication format, we recommend you put the 1756-EN2T module in a separate chassis from the 1756-ENBT module.

About the 1756-EN2T Module
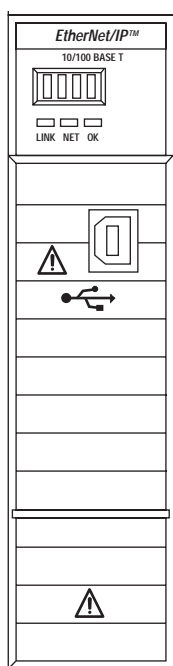
The 1756-EN2T ControlLogix EtherNet/IP bridge module performs the same functions as the 1756-ENBT but with twice the capacity for demanding applications. This module supports:

- control of I/O.
- communication via produced/consumed tags and MSG instructions.
- communication with HMI.
- configuration and programming, such as uploading and downloading.
- an adapter for 1756 I/O modules.
- USB serial communication, enabling a laptop or personal computer to access and program a Logix5000 controller. For more information, see the chapter USB Port Connection.
- a web server to provide diagnostic and status information.
- switches for quick IP address configuration.

About the 1769-L32E and 1769-L35E Modules
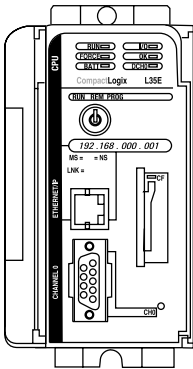
The 1769-L32E and 1769-L35E CompactLogix controllers have an integrated EtherNet/IP port. Through this port, the controller supports:

- control of I/O.
- communication via produced/consumed tags and MSG instructions.
- communication with HMI.
- configuration and programming, such as uploading and downloading.
- a web server to provide diagnostic and status information.

About the 1768-ENBT Module
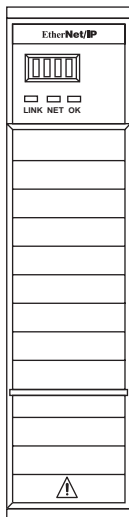
The 1768-ENBT module is an interface that enables a CompactLogix controller (1768-L43 or 1768-L45) to communicate with devices over an EtherNet/IP network. The module supports:

- control of I/O.
- communication via produced/consumed tags and MSG instructions.
- communication with HMI.
- configuration and programming, such as uploading and downloading.
- a web server to provide diagnostic and status information.

About the 1788-ENBT Module

The 1788-ENBT module operates as an interface for a FlexLogix and DriveLogix controller to communicate with other devices over an EtherNet/IP network. This module supports:

- control of I/O.
- communication via produced/consumed tags and MSG instructions.
- communication with HMI.
- configuration and programming, such as uploading and downloading.
- a web server to provide diagnostic and status information.

About the 1794-AENT Module
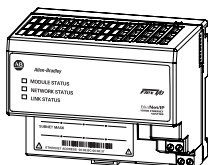
The 1794-AENT module operates as an adapter for FLEX I/O modules on an EtherNet/IP network. This module supports:

- control of I/O.
- configuration.
- a web server to provide diagnostic and status information.

About the 1734-AENT Module
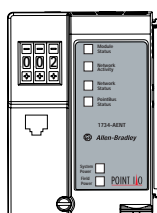
The 1734-AENT module operates as an adapter for POINT I/O modules on an EtherNet/IP network. This module supports:

- control of I/O.
- thumbwheel switches for quick IP address configuration.
- a web server to provide diagnostic and status information.

About the 20-COMM-E Module
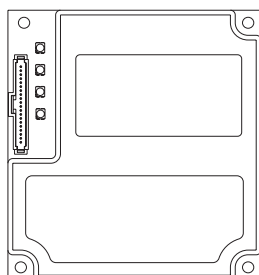
The 20-COMM-E module operates as an adapter and provides an internal EtherNet/IP connection for PowerFlex 70, 700, 700S and 700H drives, and other DPI-based host devices. This module supports:

- configuration.
- collection of data.
- peer-to-peer capability.
- a web server to provide diagnostic and status information.

About the 22-COMM-E Module
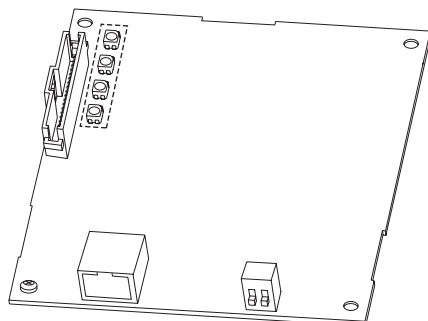
The 22-COMM-E module operates as an adapter and provides an internal EtherNet /IP connection for PowerFlex 40 ac drives. This module supports:

- user configuration of module via a process display window.
- email notification of faults.
- monitoring of diagnostics and event queue.
- direct launching of Drive Explorer or Drive Executive on personal computer to connect online over Ethernet.
- multi-drive support of up to five PowerFlex 4 and 40 ac drives to connect to a single node on EtherNet/IP, ultimately reducing hardware costs.

About Using EtherNet/IP Communication Modules in a Control System

This diagram shows how EtherNet/IP modules can fit into a control system.
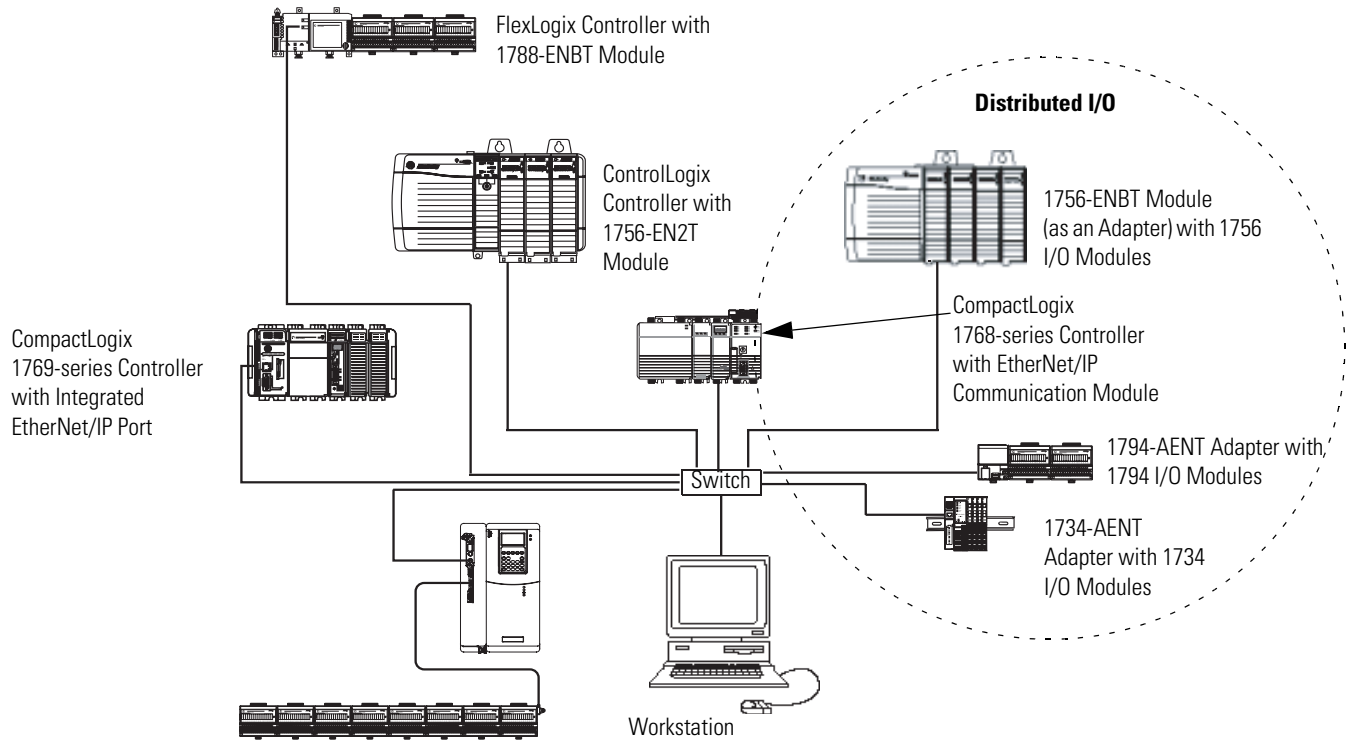
In this example:

- the controllers can produce and consume tags with each other.
- the controllers can initiate MSG instructions that send/receive data or configure devices.
- the personal computer can upload/download projects to the controllers.
- the personal computer can configure devices on the EtherNet/IP network.

About Bridging Across Networks

Some EtherNet/IP modules support the ability to bridge or route communication through devices, depending on the capabilities of the platform and communication devices.

IMPORTANT   The update time of local I/O modules may increase when bridging messages.

You have a bridge when you have a connection between communication devices on two networks. For example, this bridge device has both EtherNet/IP and DeviceNet connections, enabling

Device 1 on the EtherNet/IP network to communicate with Device 2 on a DeviceNet network through the bridge.

Bridge Device
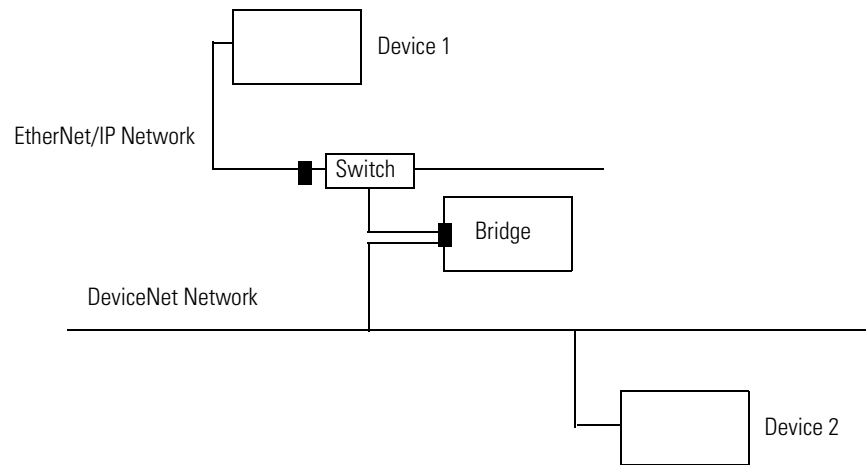
CIP messages can bridge these networks.

CIP messages that originate on this network	Can bridge to this network			
	EtherNet/IP	**ControlNet**	**DeviceNet**	**RS-232 Serial**
EtherNet/IP	Yes	Yes	Yes	Yes
ControlNet	Yes	Yes	Yes	Yes
RS-232	Yes	Yes	Yes	Yes

In this example, a workstation configures a drive on a DeviceNet network. The workstation bridges EtherNet/IP networks to reach the drive.
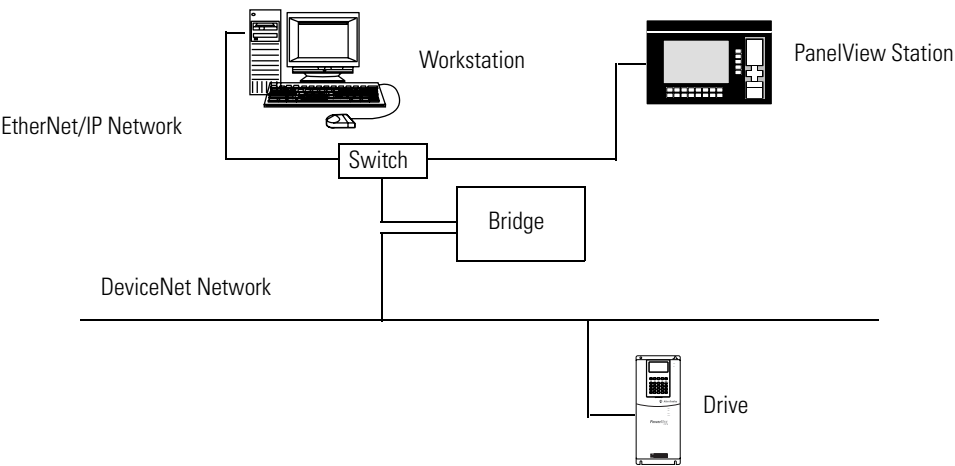
In this example, the bridge can be an EtherNet/IP to DeviceNet bridging device or a Logix5000 system with an EtherNet/IP communication module and a DeviceNet communication module. The bridge can be a:

- ControlLogix chassis with a 1756-ENBT, 1756-EN2T, or 1756-DNB module. The controller is not required.
- 1769-L32E, 1769-L35E, and 1768-L43 CompactLogix controller with a 1769-SDN module.
- FlexLogix controller with 1788-ENBT and 1788-DNBO modules.
- 1788-EN2DN linking device.

In the example above, status data can also be transferred from DeviceNet through the Logix5000 controller to a RSView32 operator interface. For a CompactLogix or FlexLogix controller, map the data into the DeviceNet I/O image and then use RSLinx OPC from the personal computer to the Logix5000 controller over the EtherNet/IP network. This avoids using the limited bridging resources of the CompactLogix or FlexLogix controller.

You cannot bridge EtherNet/IP I/O across networks. I/O modules must be configured in either a local chassis or a remote chassis. You cannot go through a gateway chassis to control I/O even though, in some circumstances, RSLogix 5000 software accepts such a configuration in the I/O Configuration folder.

This example RSLinx software screen shows how the DeviceNet bridge links to the EtherNet/IP network.

EtherNet/IP Network

EtherNet/IP Bridge in 1756 System

DeviceNet Bridge in Same 1756 System

DeviceNet Network

Distributed DeviceNet Devices
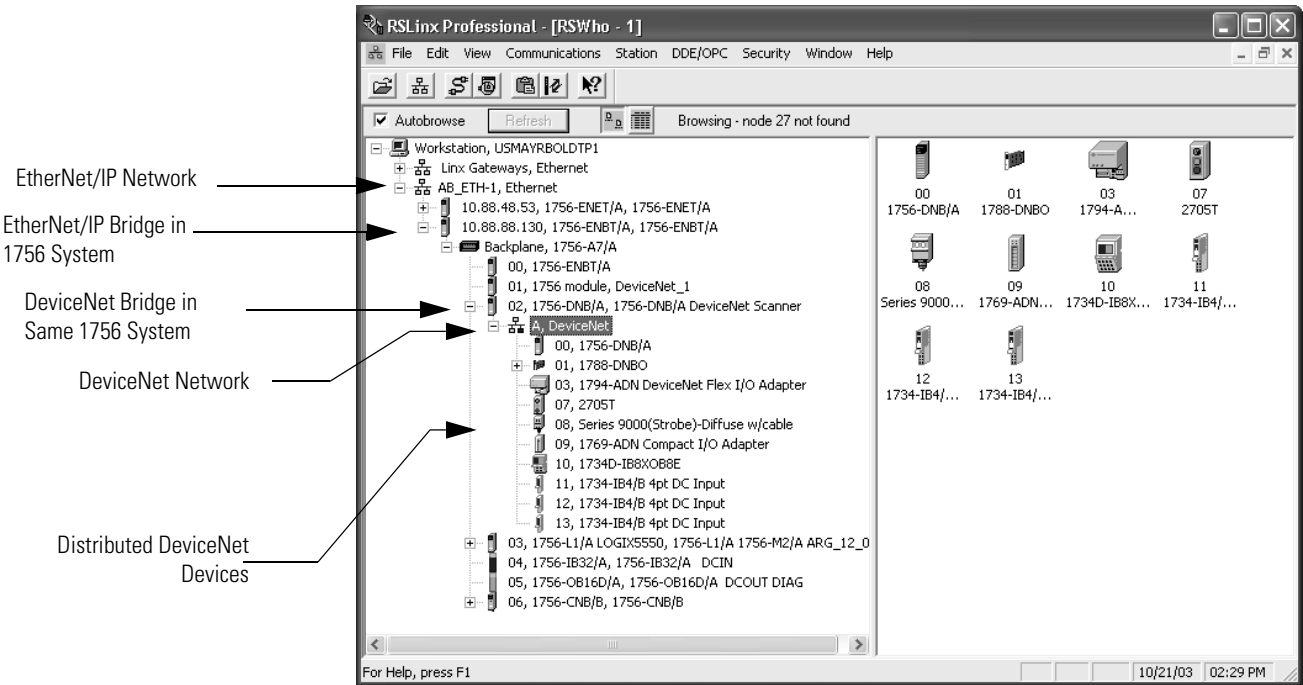
Notes:

Configure a Personal Computer To Operate on an EtherNet/IP Network

Introduction

This chapter describes how to configure a personal computer to operate on an EtherNet/IP network.

You need to load an Ethernet communication driver for all Rockwell Software applications to communicate with devices on an EtherNet/IP network. A personal computer needs this driver to:

- upload and download controller projects over the EtherNet/IP network via RSLogix 5000 programming software.
- configure EtherNet/IP network parameters for devices on the network via RSNetWorx for EtherNet/IP software.
- collect controller data for PanelView terminals and RSView applications.

Before loading a communication driver, make sure:

- the Ethernet communication card is already installed in the personal computer.
- the IP address and other network parameters are correctly configured for the personal computer.
- the personal computer is properly connected to the EtherNet/IP network.

See the documentation for the appropriate Ethernet communication module for information on installing and configuring the module.

Configure the Ethernet Communication Driver in RSLinx Software

Follow this procedure to configure the Ethernet communication driver for the personal computer (programming workstation).

1. In RSLinx software, from the Communications menu, select Configure Drivers.

2. From Available Driver Types, select EtherNet/IP Driver or Ethernet devices. and click Add New.
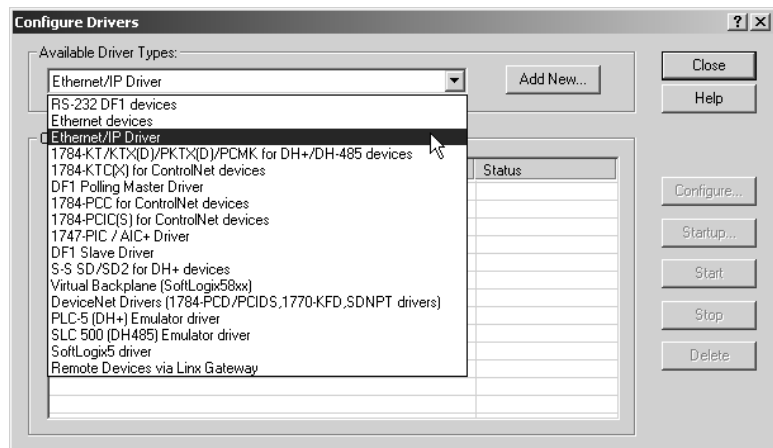
The Add New RSLinx Drive dialog appears.

This example shows the selection of an EtherNet/IP Driver that enables autobrowsing for the appropriate device. By selecting Ethernet devices, you must enter the device's IP address. See RSLinx online help for more information.

3. Choose a name for the new driver and click OK.
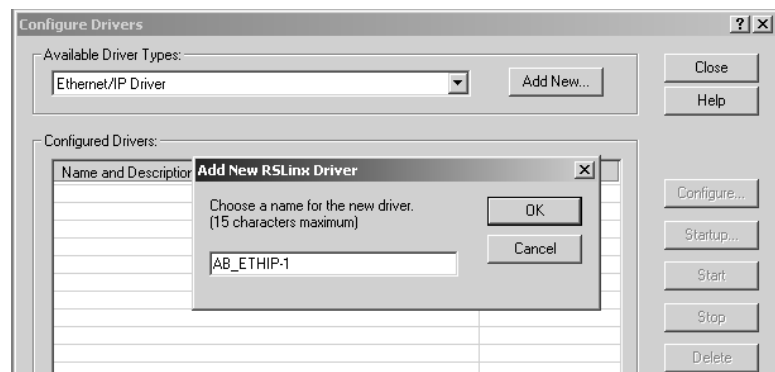
The Configure driver dialog appears.
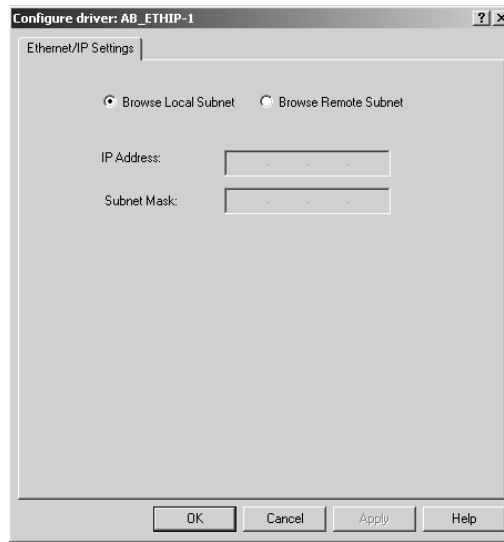
4. From the Configure driver dialog, select Browse Local Subnet.

This displays the devices on the local network so you can navigate to the EtherNet/IP communication module for the controller you want to program.

5. After navigating to the appropriate EtherNet/IP communication module, click OK.

The driver is now available.

Notes:

Configure an EtherNet/IP Module To Operate on the Network

Introduction

This chapter describes how to configure an EtherNet/IP communication module to operate on an EtherNet/IP network.

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Assign Network Parameters via the BOOTP/DHCP Utility	28
Other Methods to Assign Network Parameters	30
Duplicate IP Address Detection	33
IP Address Swapping	35
DNS Addressing	35
Use EtherNet/IP Modules in a Logix5000 Controller Application	36
Set the IP Network Address	36

When you first install a Rockwell Automation EtherNet/IP module (right out of the box), the module is BOOTP/DHCP enabled.

Determine Network Parameters

To operate on an EtherNet/IP network, you must define these parameters.

EtherNet/IP Network Parameter	Description
IP address	The IP address uniquely identifies the module. The IP address is in the form xxx.xxx.xxx.xxx where each xxx is a number between 0-255. These are reserved values you cannot use: • 127.0.0.1 • 0.0.0.0 • 255.255.255.255
Subnet mask	Subnet addressing is an extension of the IP address scheme that allows a site to use a single network ID for multiple physical networks. Routing outside of the site continues by dividing the IP address into a net ID and a host ID via the class. Inside a site, the subnet mask is used to redivide the IP address into a custom network ID portion and host ID portion. This field is set to 0.0.0.0 by default. If you change the subnet mask of an already-configured module, you must cycle power to the module for the change to take effect.
Gateway	A gateway connects individual physical networks into a system of networks. When a node needs to communicate with a node on another network, a gateway transfers the data between the two networks. This field is set to 0.0.0.0 by default.

If you use DNS addressing, or reference the module via host name in MSG instructions, define these parameters.

EtherNet/IP Network Parameter	Description
Host name	A host name is part of a text address that identifies the host for a module. The full text address of a module is *host_name.domain_name*.
Domain name	A domain name is part of a text address that identifies the domain in which the module resides. The full text address of a module is *host_name.domain_name*. The domain name has a 48-character limit. If you specify a DNS server, you must enter a domain name. Also, if you send email from the module, some mail relay servers require a domain name be provided during the initial handshake of the SMTP session.
Primary DNS server address Secondary DNS server address	This identifies the DNS server(s), if used in the network. You must have a DNS server configured if you specified a domain name or a host name in the module's configuration. The DNS server converts the domain name or host name to an IP address that can be used by the network. For more information on DNS addressing, see page 35.

Check with your Ethernet network administrator to determine if you need to specify these parameters.

Assign Network Parameters via the BOOTP/DHCP Utility

By default, the EtherNet/IP module is BOOTP enabled. The BOOTP/DHCP utility is a standalone program that is located in the:

- BOOTP-DHCP Server folder in the Rockwell Software program folder on the Start menu (the utility automatically available upon installation of RSLinx software).
- Tools directory on the RSLogix 5000 installation CD.

IMPORTANT   Before you start the BOOTP/DHCP utility, make sure you have the hardware (MAC) address of the module. The hardware address is on a sticker on the side of the EtherNet/IP module. The hardware address in a format similar to: 00-0b-db-14-55-35.

This utility recognizes BOOTP-enabled devices and provides an interface to configure a static IP address for each device.

To assign network parameters via the BOOTP/DHCP utility, perform this procedure.

1. Start the BOOTP/DHCP software.

2. Select Tool →Network Settings.

3. If appropriate for the network, enter the subnet mask, gateway address, primary/secondary server addresses, and domain name.

Network Settings

Defaults

Subnet Mask:	255	. 255	. 224	.	0
Gateway:	0	. 0	. 0	.	0
Primary DNS:	0	. 0	. 0	.	0
Secondary DNS:	0	. 0	. 0	.	0
Domain Name:					

OK   Cancel
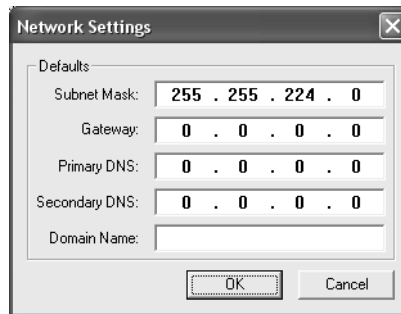
4. Click OK.

The Request History panel displays the hardware addresses of modules issuing BOOTP requests.

5. Double-click the hardware (MAC) address of the module to be configured.

The hardware address is on a sticker on the side of the EtherNet/IP module. The format of the hardware address resembles 00-0b-db-14-55-35.

BOOTP/DHCP Server 2.3

File Tools Help

Request History

Clear History   Add to Relation List

(hr:min:sec)	Type	Ethernet Address (MAC)	IP Address	Hostname
8:55:08	BOOTP	00:00:BC:21:A0:56		
8:55:02	BOOTP	00:00:BC:21:A0:56		
8:54:55	BOOTP	00:00:BC:21:A0:56		
8:54:49	BOOTP	00:00:BC:21:A0:56		

Relation List

New   Delete   Enable BOOTP   Enable DHCP   Disable BOOTP/DHCP

Ethernet Address (MAC)	Type	IP Address	Hostname	Description	

Status

Unable to service BOOTP request from 00:00:BC:21:A0:56.   Entries 0 of 256

The New Entry window appears with the module's Ethernet Address (MAC).

New Entry

Ethernet Address (MAC):	00:00:BC:21:A0:56
IP Address:	130 . 151 . 217 . 3
Hostname:	
Description:	

OK   Cancel
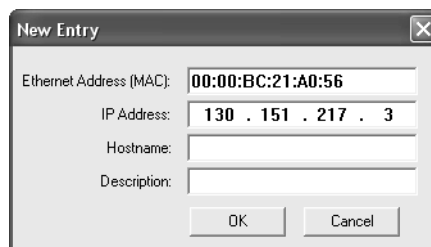
6. Enter the IP address, host name, and/or a module description.

7. Click OK.

8. To permanently assign this configuration to the module, highlight the module and click the Disable BOOTP/DHCP button.

When power is recycled, the module uses the assigned configuration and does not issue a BOOTP request.

If you do not select the Disable BOOTP/DHCP button, on a power cycle, the host controller clears the current IP configuration and will again begin sending BOOTP requests.

Other Methods To Assign Network Parameters

There are other methods to assign network parameters.

If	Use this method for assigning network parameter	Page
• A BOOTP server is not available • The EtherNet/IP module is connected to another NetLinx network	RSLinx software	31
The RSLogix 5000 project is online with the controller that communicates to or through the EtherNet/IP module	RSLogix 5000 software	32
DHCP is enabled (not BOOTP) for the EtherNet/IP module	DHCP software	33
You need to cycle power	Thumbwheel switches	36

The following factors might affect your choice of method:

- Network isolation from or integration into the plant/enterprise network
- Network size

  For large networks, even isolated networks, it might be more convenient and safer to use a BOOTP/DHCP server rather than RSLogix 5000 or RSLinx software. The BOOTP/DHCP server also limits the possibility of assigning duplicate IP addresses.

- Company policies and procedures dealing with plant floor network installation and maintenance
- Level of involvement by IT personnel in plant floor network installation and maintenance
- Type of training offered to control engineers and maintenance personnel

If you use the Rockwell Automation BOOTP or DHCP server in an uplinked subnet where an enterprise DHCP server exists, a module may get an address from the enterprise server before the Rockwell Automation utility even sees the module. You might have to

disconnect from the uplink to set the address and have the module remember its static address before reconnecting to the uplink. This is not a problem if you have node names configured in the module and leave DHCP enabled.

Use RSLinx Software To Set the IP Address

To use RSLinx to configure the EtherNet/IP module, perform this procedure.

1. Make sure the module is installed and powered up.

2. Start RSLinx.

   The RSWho window opens.

3. Navigate in RSWho to the Ethernet network.

4. Right-click the EtherNet/IP module and select Module Configuration.
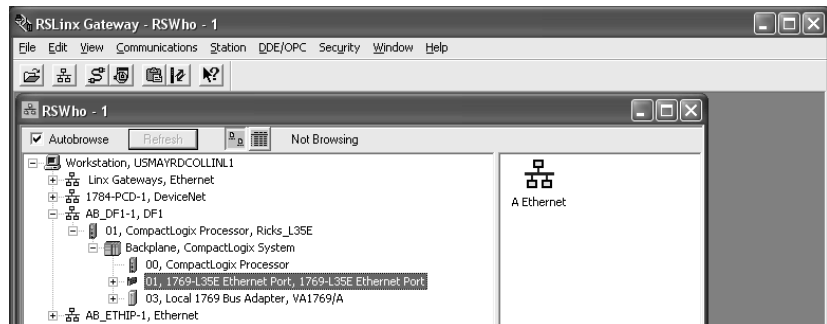
5. Select the Port Configuration tab, choose Status Network Configuration type, and enter the IP address and the other network parameters, if needed.

6. Also, select the Static radio button to permanently assign this configuration to the port.
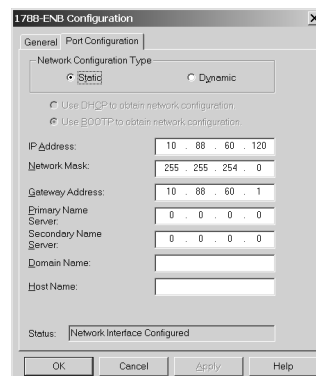
If you select Dynamic, on a power cycle, the controller clears the current IP configuration and resumes sending BOOTP requests.

Use RSLogix 5000 Software To Set the IP Address

To use RSLogix 5000 software to configure the EtherNet/IP module, perform this procedure.

1. Make sure the module is installed and powered up.

2. Connect to the controller via a serial, or other network, connection.

3. Start RSLogix 5000 software.

4. In the Controller Organizer, select properties for the EtherNet/IP module.
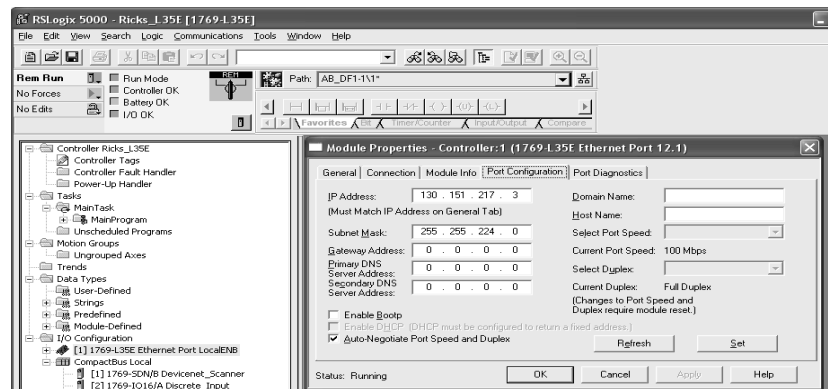
5. Select Port Configuration and specify the IP address and the other network parameters, if needed.

6. Click Apply.

7. Click OK.

   This action sets the hardware IP address. This IP address should match the IP address assigned under the General tab.

   On this screen, you can also specify port speed (10 Mbps or 100 Mbps) and duplex mode (autonegotiate, half duplex, or full duplex). All modules on the same subnet must be configured for the same port speed and duplex mode.

Use DHCP Software To Set the IP Address

Dynamic Host Configuration Protocol (DHCP) software automatically assigns IP addresses to client stations logging onto a TCP/IP network. DHCP is based on BOOTP and maintains some backward compatibility. The main difference is that BOOTP allows for manual configuration (static), while DHCP allows for both static and dynamic allocation of network addresses and configurations to newly attached modules.

Be cautious when using DHCP software to configure a module. A BOOTP client, such as the EtherNet/IP modules, can boot from a DHCP server only if the DHCP server is specifically written to also handle BOOTP queries. This is specific to the DHCP software package used. Consult your system administrator to see if a DHCP package supports BOOTP commands and manual IP allocation.

ATTENTION	The EtherNet/IP module must be assigned a fixed network address. The IP address of this module must not be dynamically provided.
⚠	Failure to observe this precaution may result in unintended machine motion or loss of process control.

Duplicate IP Address Detection

These EtherNet/IP modules (and their future revisions) support duplicate IP address detection:

- 1756-ENBT, firmware revision 3.2 and greater
- 1756-EN2T, firmware revision 1.x and greater
- 1768-ENBT, firmware revision 1.x and greater
- 1769-L32E and 1769-L35E, firmware revision 15.01 and greater (For more information, see the CompactLogix User Manual, publication 1769-UM011.)
- 1788-ENBT, firmware revision 2.1 and greater
- 1756-EWEB, firmware revision 2.2 and greater (For more information, see the EtherNet/IP Web Server Module User Manual, publication ENET-UM527.)
- 1768-EWEB, firmware revision 1.x and greater
- 1734-AENT, firmware revision 2.1 and greater
- 1794-AENT, firmware revision 3.x and greater
- 2x-COMM-E, firmware revision 1.1 and greater

When you change the IP address or connect one of these modules to an EtherNet/IP network, the module checks to make sure that the IP address assigned to this module does not match the address of any

other network device. If the module determines that there is a conflict (another device on the network with a matching IP address), the EtherNet/IP port of the module goes into conflict mode, where the module's:

- OK LED blinks red.
- Network (NET) LED is solid red.
- Front display indicates the conflict (1756-ENBT only).

  The display scrolls:OK <IP_address_of_this_module> Duplicate IP <Mac_address_of_duplicate_node_detected>

  For example: OK 10.88.60.196 Duplicate IP - 00:00:BC:02:34:B4

To correct this conflict, use the instructions in this chapter to change the IP address of the module. Then cycle power to the module or reset the module (such as disconnecting the EtherNet/IP cable and reconnecting the cable).

There is also the possibility that two modules can detect a conflict simultaneously. If this occurs, remove the module with the incorrect IP address or correct its conflict. To get the second module out of conflict mode, cycle power to the module or disconnect its EtherNet/IP cable and reconnect the cable.

Duplicate Detection Scenarios

The behavior of devices that are in conflict over an IP address varies depending on whether connections have been established to either of the modules and whether both modules support duplicate IP address detection.

- If both modules support duplicate IP address detection, the module that powers up first and uses the IP address keeps the IP address. The other module will detect a conflict, give up the IP address, and enter conflict mode.
- If both modules support duplicate IP address detection and power up at roughly the same time, they surrender the IP address and enter conflict mode.
- If one module supports duplicate IP address detection and a second module does not, the second module generally keeps its IP address, regardless of which module obtains the IP address first. The module that supports duplicate IP address detection will detect the conflict and give up the IP address.

IP Address Swapping

These EtherNet/IP modules (and their future revisions) support IP address swapping in ControlLogix redundancy systems:

- 1756-ENBT, firmware revision 3.1 and greater
- 1756-EWEB, firmware revision 2.2 and greater

During a switchover in ControlLogix redundancy systems, these modules swap their IP addresses with their partner modules in the other redundant chassis.

For more information about IP address swapping, see the ControlLogix Redundancy User Manual, publication 1756-UM523.

DNS Addressing

To further qualify a module's address, use DNS addressing to specify a host name for a module, which also includes specifying a domain name and DNS servers. DNS addressing makes it possible to set up similar network structures and IP address sequences under different domains.

DNS addressing is only necessary if you refer to the module by host name, such as in path descriptions in MSG instructions.

To use DNS addressing, perform this procedure.

1. Assign a host name to the module.

   A network administrator should be able to assign a host name. Valid host names should be IEC-1131-3 compliant.

2. Configure the module's parameters.

3. In addition to the IP address, subnet mask, and gateway address, configure a host name for the module, domain name, and primary/secondary DNS server addresses.

   In the DNS server, the host name must match the IP address of the module.

IMPORTANT   Make sure the DNS enable bit is set

If you configure your module using RSLinx 2.41.00, the enable bit is cleared and DNS addressing will not work. If you configure your module using the Port Configuration tab in RSLogix 5000 software, the enable bit is set, so DNS addressing should work.

---

4. In RSLogix 5000 software, add the module to the I/O configuration tree.

5. Enter the host name in the General tab of the module.

If a child module resides in the same domain as its parent module, just enter the host name. If the child module's domain differs from that of its parent module, enter the host name and the domain name (host.domain)

You can also use DNS addressing in a module profile in the I/O controller tree or in a message path. If the destination module's domain name differs from that of the source module, use a fully-qualified DNS name (hostname.domainname). For example, to send a message from ENBT1.location1.companyA to ENTB1.location2.companyA, the host names match, but the domains differ. Without the entry of a fully qualified DNS name, the module adds the default domain name to the specified host name.

Use EtherNet/IP Modules in a Logix5000 Controller Application

After installing an EtherNet/IP module and setting its IP address, add the module to the Controller Organizer in an RSLogix 5000 project. This addition establishes I/O control.

You must download that project to the host controller before operation can begin. When the controller begins operation, it establishes a connection with the EtherNet/IP module. The module's configuration determines its behavior.

For information on configuring and placing a personal computer (for developing an RSLogix 5000 project) on an EtherNet/IP network, see the chapter Configure a Personal Computer to Operate on an EtherNet/IP Network.

For information on controlling I/O, see the chapter Control I/O.

Set the IP Network Address

The 1734-AENT and 1756-EN2T EtherNet/IP modules ship with the IP address configuration switches set to 999 and DHCP enabled. You can set the network Internet Protocol (IP) address in these ways:

- Use the switches on the module.

- Use a Bootstrap Protocol (BOOTP)/Dynamic Host Configuration Protocol (DHCP) server, such as the Rockwell Automation BOOTP-DHCP server utility.
- Use RSLinx or RSLogix 5000 programming software.

EtherNet/IP Modules - IP Address Configuration Switches

1734-AENT EtherNet/IP Module

1756-EN2T EtherNet/IP Module

Front of Module

Top of Module

IP Network Address Thumbwheel Switches

IP Network Address Rotary Switches

43248
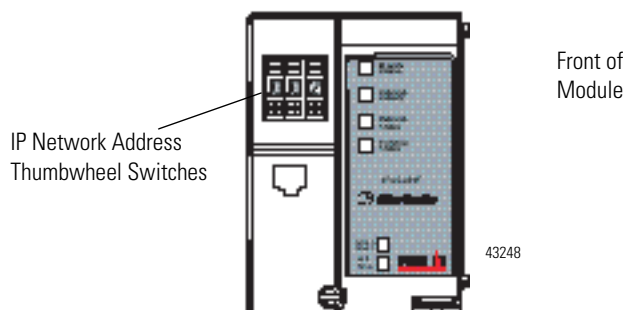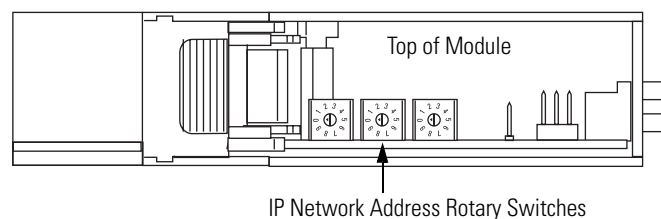
IMPORTANT	The adapter reads the configuration switches **only when you cycle power** to determine if the switches are set to a valid number.

Valid settings range from 001...254.

IP Network Address Configuration Switch Settings

If the	Then
Switches are set to a valid number	• The adapter's IP address will be 192.168.1.xxx (where xxx represents the number set on the switches). • The adapter's subnet mask will be 255.255.255.0 and the gateway address is set to 0.0.0.0. • The adapter will not have a host name assigned, or use any Domain Name System when using the thumbwheel settings.
Switches are set to an invalid number (such as 000 or a value greater than 254)	• The module checks to see if DHCP or BOOTP is enabled. If it is, the module requests an IP address from a DHCP/BOOTP server. The DHCP/BOOTP server will also assign other Transport Control Protocol (TCP) parameters. • If you have used software to preconfigure an IP address, and DHCP or BOOTP is disabled, the module will use the configured IP address.
DHCP is not enabled	• The adapter will use the IP address (along with other TCP configurable parameters) stored in nonvolatile memory. **Important:** The factory default switch setting is 999, and DHCP is enabled.

Control I/O

Introduction

This chapter describes how a controller controls distributed I/O over an EtherNet/IP network. The controller requires a communication module to connect to the network. Distributed I/O modules require an adapter to connect to the network.

Topic	Page
Set Up the Hardware	39
Set the Requested Packet Interval (RPI)	40
Select a Communication Format	40
Add Distributed I/O	46
Access Distributed I/O	48

Set Up the Hardware

In this example, the Logix5000 controller has an EtherNet/IP communication module to connect to the EtherNet/IP network. The distributed (remote) I/O has an EtherNet/IP adapter to connect it to the EtherNet/IP network.

Distributed I/O over an EtherNet/IP Network

Local Chassis
Logix5000 Controller
with EtherNet/IP
Communication Module

Data

Distributed I/O
EtherNet/IP Adapter
with I/O Modules

Switch

Programming
Terminal
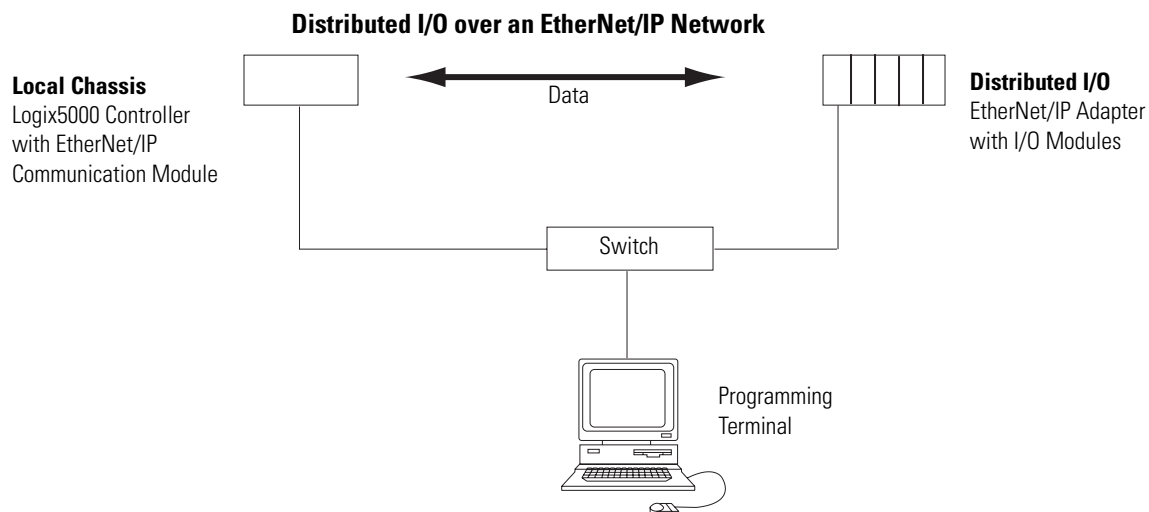
The Logix5000 controller can communicate with each I/O module directly (direct connection). Or you can configure a rack-optimized connection to the EtherNet/IP adapter to send data to any digital I/O modules. Analog modules always require direct connections.

You must:

- set the IP addresses for each EtherNet/IP module.
- connect all wiring and cabling properly.
- configure the communication driver (such as AB-ETHIP-1) for the programming workstation.

Set the Requested Packet Interval (RPI)

When you configure an I/O module, you define the requested packet interval (RPI) rate for the module.

The RPI specifies the period at which data updates over a connection. For example, an input module sends data to a controller at the RPI that you assign to the module. Configure the RPI in milliseconds.

RPIs are used only for modules that produce data. For example, a local EtherNet/IP communication module requires no RPI because it produces no data for the system but acts only as a bridge.

In Logix5000 controllers, I/O values update at an interval set via the project's I/O configuration folder. The values update asynchronous to the execution of logic. At the specified interval, the controller updates a value independently from the execution of logic.

Only set the RPI to the rate the application requires. The RPI also determines the number of packets per second that the module will produce on a connection. Each module can only produce a limited number of packets per second. Exceeding this limit prevents the module from opening more connections.

For information on RPI and how it affects the actual packet interval (API), see the EtherNet/IP Performance Application Solution, publication ENET-AP001.

Select a Communication Format

When configuring an I/O module, select its communication format. The chosen communication format determines the data structure for the module's tags. Many I/O modules support different formats. Each format uses a different data structure. The chosen communication format determines:

- direct or rack-optimized connection.
- ownership.

The available communication formats depend on the type of I/O module.

If you have this type of I/O module	And want	Select a communication format that specifies
Digital	A rack-optimized connection	Rack Optimization
	To use specialty features of the module, such as diagnostics, timestamps, or electronic fuses	Full Diagnostics CST Timestamped
Digital	A direct connection	Scheduled Data Input Data Output Data
Analog	A direct connection (only direct connection is supported for analog modules)	Float Data Integer Data CST Timestamped

See online help in RSLogix 5000 programming software for specific communication formats per I/O module.

Choose Direct or Rack-optimized Connection

The Logix5000 controller uses connections to transmit I/O data. These connections can be direct connections or rack-optimized connections.

Term	Definition
Direct connection	A direct connection is a real-time, data transfer link between the controller and an I/O module. The controller maintains and monitors the connection with the I/O module. Any break in the connection, such as a module fault or the removal of a module while under power, sets fault bits in the data area associated with the module.

A direct connection is any connection that does not use the Rack Optimization Comm Format. ⟶

Module Properties - Local (1756-IB16 2.1)
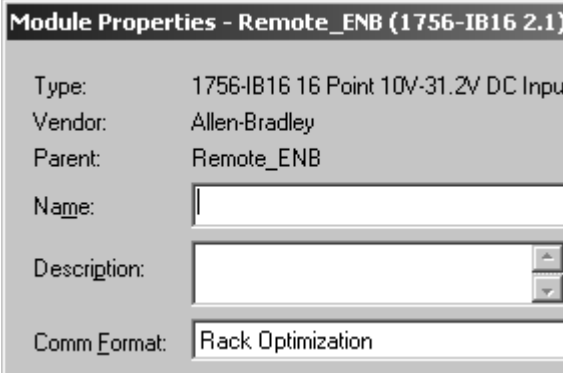
Type: 1756-IB16 16 Point 10V-31.2V DC Inpu
Vendor: Allen-Bradley
Parent: Local
Name:
Description:
Comm Format: Input Data

Term	Definition
Rack-optimized connection	For digital I/O modules, you can select rack-optimized communication. A rack-optimized connection consolidates connection usage between the controller and all the digital I/O modules in the chassis (or DIN rail). Rather than having individual, direct connections for each I/O module, there is one connection for the entire chassis (or DIN rail).

Rack-optimized connection ⟶

Module Properties - Remote_ENB (1756-IB16 2.1)

Type:	1756-IB16 16 Point 10V-31.2V DC Inpu
Vendor:	Allen-Bradley
Parent:	Remote_ENB
Na<u>m</u>e:	
Descri<u>p</u>tion:	
Comm <u>F</u>ormat:	Rack Optimization

IMPORTANT   If you use various 1756 EtherNet/IP communication modules, for example a 1756-ENBT with a 1756-EN2T, in the same chassis, do not use the rack-optimized communication format. If you must use the rack-optimized communication format, we recommend you put the 1756-EN2T module in a separate chassis from the 1756-ENBT module.

Direct Connections For I/O Modules

In this example, assume that each distributed I/O module is configured for a direct connection to the controller.

Controller With EtherNet/IP Communication Module

EtherNet/IP Network

Switch

EtherNet/IP Adapters With I/O Modules

Digital I/O Modules   Analog I/O Modules   Digital I/O Modules
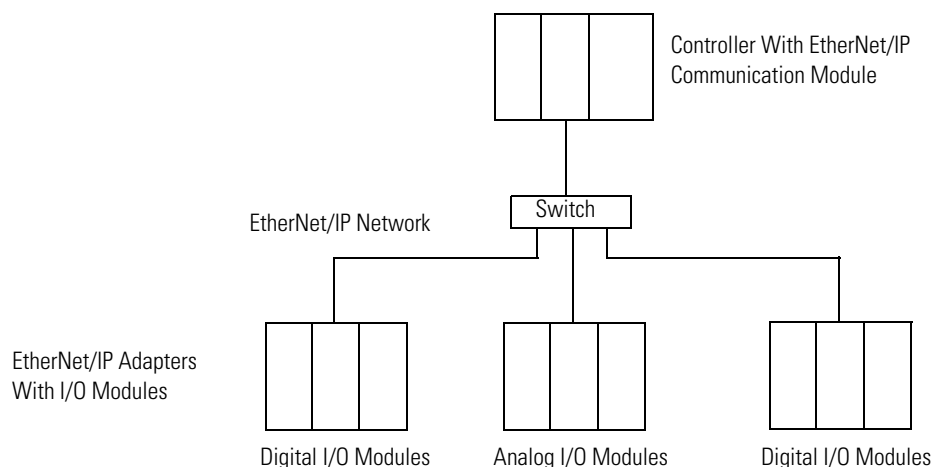
This table calculates the connections in this example.

System Connections	Amount
Controller to local EtherNet/IP communication module	0
Controller to EtherNet/IP adapter Direct connection for digital I/O module	4
Direct connection for analog I/O module	2
Total connections used	6

If you have many modules, direct connections to each module may not be feasible because you could use up the number of connections and packets per second supported by the module.

Refer to Rack-optimized Connections For I/O Modules on page 43 to conserve connection use and network traffic.

Rack-optimized Connections For I/O Modules

In this example, assume that each digital I/O module is configured for a rack-optimized connection to the controller. Analog modules must be configured for direct connections.
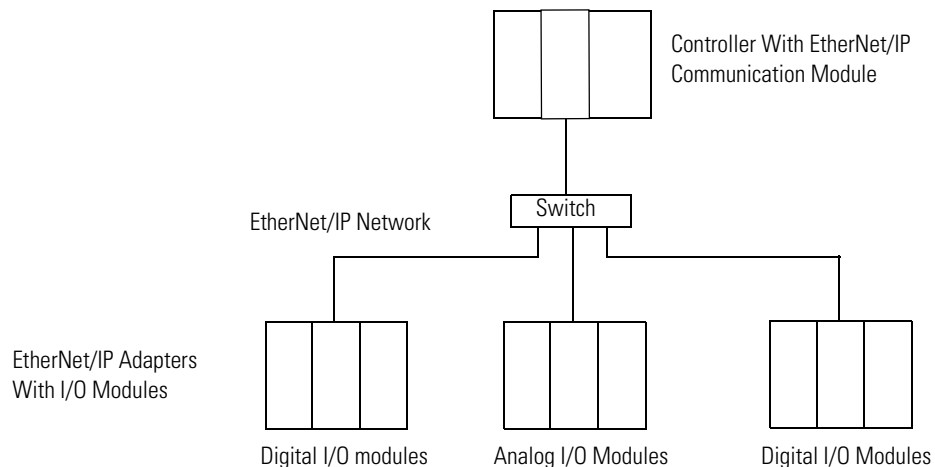
The following table calculates the connections in this example.

System Connections	Amount
Controller to local EtherNet/IP communication module	0
Controller to EtherNet/IP adapter with digital modules (rack-optimized connection to each adapter)	2
Controller to EtherNet/IP adapter with analog modules (direct connection for each analog I/O module)	2
Total Connections used	4

The rack-optimized connection conserves connections, but can limit the status and diagnostic information that is available from the I/O modules.

To optimize the number of available connections, use a rack-optimized connection between any digital I/O that allows it and the remote adapter that connects the distributed I/O to the controller via the communication module.

Ownership

In a Logix5000 system, modules multicast data. Therefore, multiple modules can receive the same data at the same time from a single module. When choosing a communication format, decide whether to establish an owner-controller or listen-only relationship with the module.

Owner controller	The controller that creates the primary configuration and communication connection to a module. The owner controller writes configuration data and can establish a connection to the module.

An owner connection is any connection that does not include Listen-Only in its Comm Format. ⟶

Module Properties - Local (1756-IB16 2.1)

Type:	1756-IB16 16 Point 10V-31.2V DC Inpu
Vendor:	Allen-Bradley
Parent:	Local
Name:	
Description:	
Comm Format:	Input Data

Listen-only connection	An I/O connection where another controller owns/provides the configuration data for the I/O module. A controller using a listen-only connection only monitors the module. It does not write configuration data and can only maintain a connection to the I/O module when the owner controller is actively controlling the I/O module.

Module Properties - Local (1756-IB16 2.1)

Type:	1756-IB16 16 Point 10V-31.2V DC Inpu
Vendor:	Allen-Bradley
Parent:	Local
Name:	
Description:	
Comm Format:	Listen Only - Input Data

Listen-only connection ⟶

Use this table to choose the type of ownership for a module.

If the module is an	And another controller	And you want to	Then use this type of connection
Input module	Does not own the module	————————————➤	Owner (for example, not listen-only)
	Owns the module	Maintain communication with the module if it loses communication with the other controller	Owner (for example, not listen-only) Use the same configuration as the other owner controller.
		Stop communication with the module if it loses communication with the other controller	Listen-only
Output module	Does not own the module	————————————➤	Owner (for example, not listen-only)
	Owns the module	————————————➤	Listen-only

Controlling input modules differ significantly from controlling output modules.

Control	This Ownership	Description
Input modules	Owner	An input module is configured by a controller that establishes a connection as an owner. This configuring controller is the first controller to establish an owner connection. Once an input module has been configured (and owned by a controller), other controllers can establish owner connections to that module. This allows additional owners to continue to receive multicast data if the original owner controller breaks its connection to the module. Additional owners must have the identical configuration data and communications format as the original owner controller; otherwise, the connection attempt is rejected.
	Listen-only	Once an input module has been configured (and owned by a controller), other controllers can establish a listen-only connection to that module. These controllers can receive multicast data while another controller owns the module. If all owner controllers break their connections to the input module, all controllers with listen-only connections no longer receive multicast data.
Output modules	Owner	An output module is configured by a controller that establishes a connection as an owner. Only one owner connection is allowed for an output module. If another controller attempts to establish an owner connection, the connection attempt is rejected.
	Listen-only	Once an output module has been configured (and owned by one controller), other controllers can establish listen-only connections to that module. These controllers can receive multicast data while another controller owns the module. If the owner controller breaks its connection to the output module, all controllers with listen-only connections no longer receive multicast data.

If the module is also in the I/O configuration of another controller, select the Listen Only version of the Comm Format (for example, Listen Only - Input Data).

Add Distributed I/O

To communicate with a system's I/O modules, add bridge, adapter, and I/O modules to the controller's I/O Configuration folder. Within the folder, organize the modules into a hierarchy (tree/branch, parent/child).

For a typical distributed I/O network…

```
┌────────────┬──────────────┐        ┌──────────┬──────────┐
│            │    Local     │        │          │          │
│ Controller │Communication │────────│  Remote  │   I/O    │
│            │   Module     │        │ Adapter  │  Module  │
└────────────┴──────────────┘        └──────────┴──────────┘
                                                      │
                                              ┌──────────────┐
                                              │    Device    │
                                              └──────────────┘
```
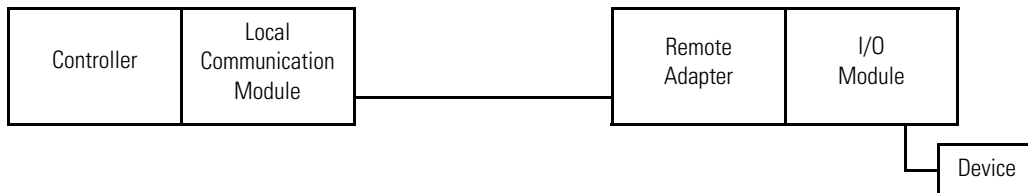
…you build the I/O configuration in this order.

1. Add the local communication module (bridge).

2. Add the remote adapter for the distributed I/O chassis or DIN rail.

3. Add the I/O module.
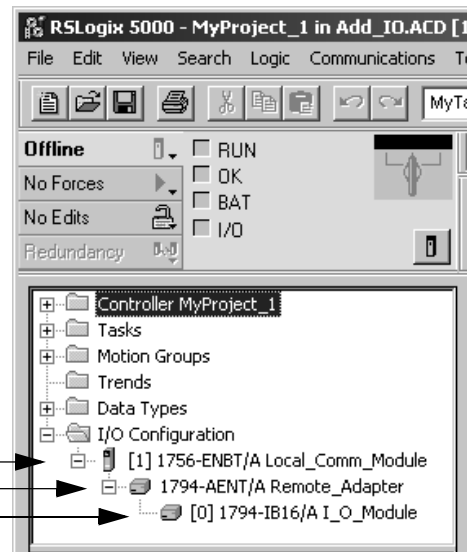
| IMPORTANT | I/O is controlled on the same subnet and can't be processed via a router. |

Add a Module

To add a module to the I/O Configuration folder, perform this procedure.

1. Right-click the level (branch) to which you want to add the module and choose New Module.
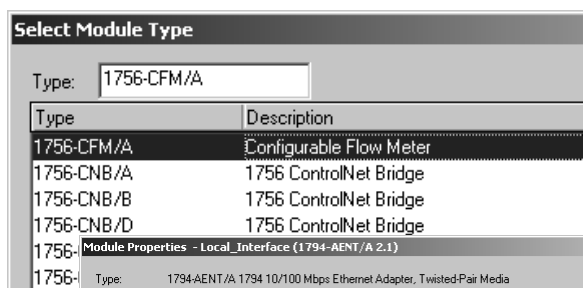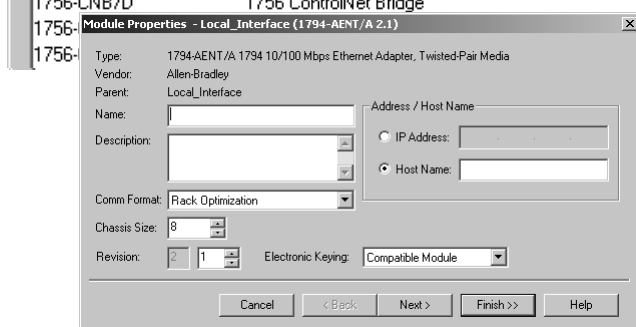
2. Choose the module.

3. Configure the module.

To	Do This
Use the default configuration	Specify the general information about the module (name or comm format) and click Finish.
Customize the configuration	Specify the general information about the module (name or comm format). Then use the Next buttons to progress through subsequent screens.

The Comm Format selected when adding a communication module and its I/O modules makes it possible to set up rack-optimized or direct connections to each distributed I/O module.

If the distributed I/O is	Select this format for the remote adapter	Select this format for the distributed I/O module
Digital	Rack optimization	Rack optimization
Analog	None	An appropriate direct-connection format

Select a Remote Adapter

The type of distributed I/O dictates the choice of remote adapter.

If the distributed I/O is	Select this remote adapter
1756 ControlLogix I/O	1756-ENBT or 1756-EN2T
1794 FLEX I/O	1794-AENT
1734 POINT I/O	1734-AENT

Access Distributed I/O

I/O information is presented as a structure of multiple fields, which depends on the specific features of the I/O module. The name of the structure is based on the location of the I/O module in the system. Each I/O tag is automatically created when you configure the I/O module through the programming software. Each tag name follows this format:

Location:SlotNumber:Type.MemberName.SubMemberName.Bit

where:

This address variable	Is
Location	Identifies network location LOCAL = local DIN rail or chassis ADAPTER_NAME = identifies remote adapter or bridge
SlotNumber	Slot number of I/O module in its chassis
Type	Type of data I = input O = output C = configuration S = status
MemberName	Specific data from the I/O module, which depends on the type of data the module can store For example, Data and Fault are possible fields of data for an I/O module. Data is the common name for values the are sent to or received from I/O points.
SubMemberName	Specific data related to a MemberName
Bit (optional)	Specific point on the I/O module, which depends on the size of the I/O module (0...31 for a 32-point module)

EXAMPLE
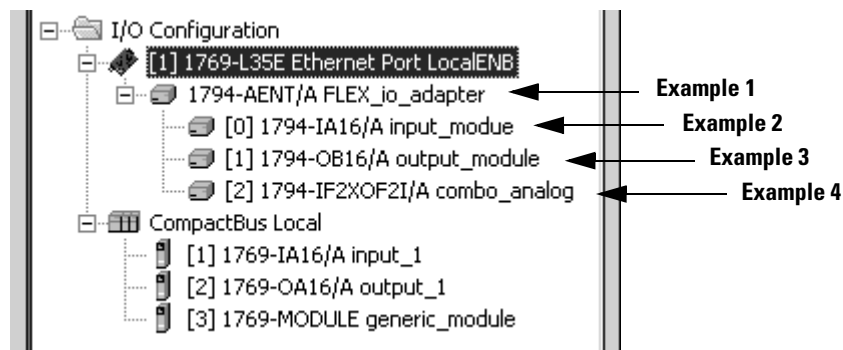
Module	Example Tag Names (automatically created by the software)

Remote 1794-AENT adapter "FLEX_io_adapter"	FLEX_io_adapter:I
	    FLEX_io_adapter:I.SlotStatusBits
	    FLEX_io_adapter:I.Data
	FLEX_io_adapter:O
	    FLEX_io_adapter:O.Data

Remote 1794-IA16 "input_module" in slot 0
 	
Rack-optimized connection
	FLEX_io_adapter:0:C
	    FLEX_io_adapter:0:C.Config
	    FLEX_io_adapter:0:C.DelayTime_0
	    FLEX_io_adapter:0:C.DelayTime_1
	    FLEX_io_adapter:0:C.DelayTime_2
	    FLEX_io_adapter:0:C.DelayTime_3
	    FLEX_io_adapter:0:C.DelayTime_4
	    FLEX_io_adapter:0:C.DelayTime_5
	FLEX_io_adapter:0:I

Remote 1794-OB16 "output_module" in slot 1
 	
Rack-optimized connection
	FLEX_io_adapter:1:C
	    FLEX_io_adapter:1:C.SSData
	FLEX_io_adapter:1:O
	    FLEX_io_adapter:1:O.Data

Remote 1794-IF2XOF2I "combo_analog" in slot 2
 	
Direct connection
	FLEX_io_adapter:2:C
	    FLEX_io_adapter:2:C.InputFIlter
	    FLEX_io_adapter:2:C.InputConfiguration
	    FLEX_io_adapter:2:C.OutputConfiguration
	    FLEX_io_adapter:2:C.RTSInterval
	    FLEX_io_adapter:2:C.SSCh0OuputData
	    FLEX_io_adapter:2:C.SSCH1OutputData
	FLEX_io_adapter:2:I

The choice of rack optimization for an I/O module creates tags as aliases for the adapter module's tags. This logic displays the device's tag as an alias for a the adapter module's tag. In this example, the tag name of the adapter is in angle brackets.

Tag Name of the I/O Device   Tag Name of the Adapter

Conveyor:2:I.0
<Conveyor:I.Data[2].0>
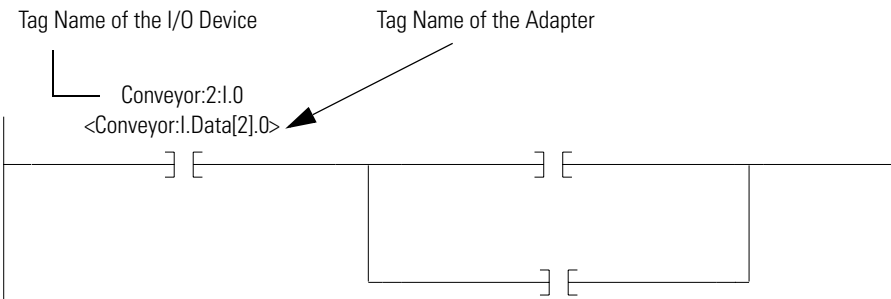
Interlocking and Data Transfer between Controllers

Introduction

This chapter describes how to share data by interlocking controllers (producing and consuming tags) and transferring messages between controllers via an EtherNet/IP network.

Different methods of communicating with other controllers exist.

If you want to	And the data	Then	See page
Interlock operations	Resides on Logix5000 controllers	Produce and consume a tag	53
Transfer data	Needs regular delivery at an interval that you specify	Produce and consume a tag	53
	Is sent when a specific condition occurs in your application	Execute a message (MSG) instruction	59

Set Up the Hardware

In this example, the controller in the local chassis can produce a tag that is consumed by the controller in the remote chassis. The local controller can also send a MSG instruction to the remote controller.
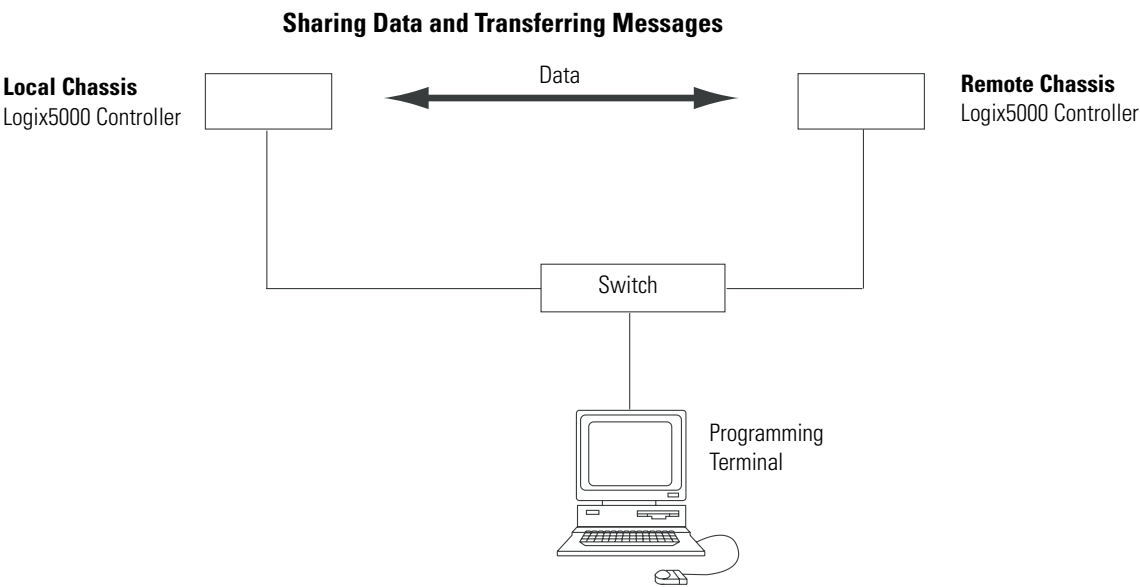
Sharing Data and Transferring Messages

Logix5000 Controller Combinations

These controllers	Can combine with
1756 ControlLogix	1756-ENBT or 1756-EN2T communication module
1768 CompactLogix	1768-ENBT communication module
1769-L32E and 1769-L35E CompactLogix	A built-in EtherNet/IP port
1794 FlexLogix	1788-ENBT EtherNet/IP communication card
PowerFlex 700S with DriveLogix controller	1788-ENBT EtherNet/IP communication card

Make sure to:

- set the IP addresses and other network parameters for each EtherNet/IP communication module.
- connect all wiring and cabling.
- configure the communication driver (such as AB-ETHIP-1) for the programming workstation.

TIP   If you are sharing tags between ControlLogix controllers and the controllers are sharing only tags (not sending messages), set the communication format of the 1756-ENBT or 1756-EN2T module to None.

Organize Tags for Produced or Consumed Data

To properly organize tags for produced or consumed data (shared data), follow these guidelines.

Guideline	Details
Create the tags at the controller scope.	You can share only controller-scoped tags.
Use one of these data types: • DINT • REAL • array of DINTs or REALs • user-defined	• To share other data types, create a user-defined data type that contains the required data. • Use the same data type for the produced tag and corresponding consumed tag or tags.
Limit the size of the tag to ≤500 bytes.	If transferring more than 500 bytes, create logic to transfer the data in packets. A size of < 125 DINT words will keep total bytes within 500. This helps reduce the total number of packets for transactions.
Combine data that goes to the same controller.	If producing several tags for the same controller: • Group the data into one or more user-defined data types. (This uses fewer connections than producing each tag separately.) • Group the data according to similar update intervals. (To conserve network bandwidth, use a greater RPI for less critical data.) For example, you could create one tag for data that is critical and another tag for data that is not as critical.

Terminology

A Logix5000 controller can produce (broadcast) and consume (receive) system-shared tags.

Term	Definition
Produced tag	A tag that a controller makes available for use by other controllers. Multiple controllers can simultaneously consume (receive) the data. A produced tag sends its data to one or more consumed tags (consumers) without using logic. The produced tag sends its data at the RPI of the consuming tag.
Consumed tag	A tag that receives the data of a produced tag. The data type of the consumed tag must match the data type (including any array dimensions) of the produced tag. The RPI of the consumed tag determines the period at which the data updates.

To share produced or consumed tags, two controllers must be attached to the same EtherNet/IP subnet. Two controllers cannot bridge produced or consumed tags over two subnets.

Determine Connections for Produced and Consumed Tags

Logix controllers can produce (broadcast) and consume (receive) system-shared tags that are sent and received via the EtherNet/IP communication module. Produced and consumed tags each require connections.

This type of tag	Requires these connections
Produced	The local controller (producing) must have one connection for the produced tag and the first consumer and one more connection for each additional consumer (heartbeat). The produced tag requires two connections. As you increase the number of controllers that can consume a produced tag, you also reduce the number of connections the controller has available for other operations, such as communications and I/O.
Consumed	Each consumed tag requires one connection for the controller that is consuming the tag.

All EtherNet/IP modules support as many as 32 produced connections. Additionally, the total number of tags that can be produced or consumed is limited by the number of available connections. If the communication module uses all of its connections for I/O and other communication modules, no connections are left for produced and consumed tags.

Each produced or consumed tag uses the following number of connections:

This controller	And this type of tag	Use this many connections
ControlLogix	Produced tag	Number_of_consumers
SoftLogix5800	Consumed tag	1
CompactLogix	Produced tag	Number_of_consumers
DriveLogix FlexLogix	Consumed tag	1

TCP and CIP connection capacities vary for all EtherNet/IP modules.

Module	Packets/Second	TCP Connections	CIP Connections
1756-ENBT	5000	64	128
1756-EN2T	10,000	128	256
1769-L32E	4000	32	32
1769-L35E	4000	32	32
1768-ENBT	5000	32	64
1788-ENBT	4000	64	32
1734-AENT	5000	64	20
1794-AENT	9500	64	64
2x-COMM-E	400	30	16

Produce a Tag

To produce a tag, configure the produced tag in the RSLogix 5000 project for the local (producer) controller. You do not have to configure the consumer controller(s) in the I/O Configuration folder of the producer controller.

Configure the Produced Tag

```
□─⊟ Controller Controller_1
   ├─ 🖉 Controller Tags          ◄──
   ├─ 🗀 Controller Fault Handler
   └─ 🗀 Power-Up Handler
```
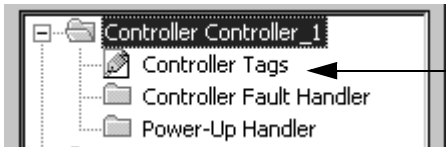
1. In the producer's controller organizer, right-click the Controller Tags folder and select Edit Tags.

   You can produce only controller-scoped tags.

2. In the Controller Tags window, right-click the tag that you want to produce and choose Edit Tag Properties.

3. Under Tag Type, select Produced.

```
🔳 Tag Properties - Produced_Tag                          _ ▫

  General* | Connection |

  Name:          Produced_Tag

  Description:                              ▲
                                           ▼

  Tag Type:      ○ Base
                 ○ Alias
      ──────►    ⦿ Produced
                 ○ Consumed
```

4. Select Connection.

5. Type or select the maximum number of controllers that will consume (receive) the tag.

```
🔳 Tag Properties - Produced_Tag                          _ ▫

  General | Connection* |

  ──────► Maximum Consumers:    [    ] ⬍

          ☐ Send Data State Change Event To Consumer(s)
```

6. Click OK.

Consume Data Produced by Another Controller

To consume a produced tag, specify both the producer controller and the produced tag in the RSLogix 5000 project for the remote (consumer) Logix5000 controller.

Add the Producer Controller to the Consumer's I/O Configuration

Add the producer controller to the remote controller's I/O Configuration folder. In the folder, organize the controllers and communication modules into a hierarchy (tree/branch, parent/child).

For a typical producer/consumer structure…

Consumer Controller	Local Communication Module		Remote Communication Module	Producer Controller

…build the I/O configuration in this order:

1. Add the local communication module for the consumer controller.

2. Add the remote communication module for the producer controller.

3. Add the producer controller.

Perform this procedure to add a module to the I/O Configuration folder.

1. Right-click the level (branch) to which you want to add the module and choose New Module.

2. Choose the module.

3. Configure the module.

To	Do This
Use the default configuration	Specify the general information about the module (name, comm format) and click Finish.
Customize the configuration	Specify the general information about the module (name, comm format). Then use the Next buttons to step through subsequent screens.

Create the Consumed Tag

To create the consumed tag, perform this procedure.
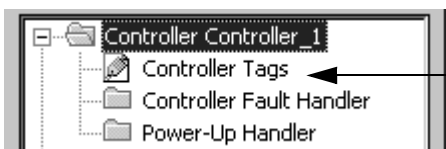
1. In the consumer controller's project, right-click the Controller Tags folder and choose Edit Tags.

   Only controller-scoped tags can consume data.

2. In the Controller Tags window, right-click the tag that will consume the data and choose Edit Tag Properties.

3. Select Consumed.

Make sure the data type is the same as the produced tag.
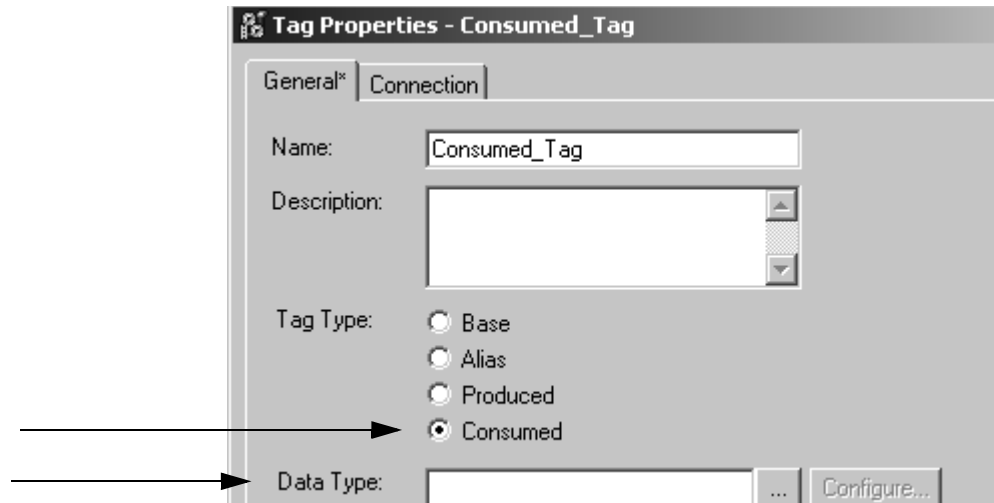
4. Select Connection
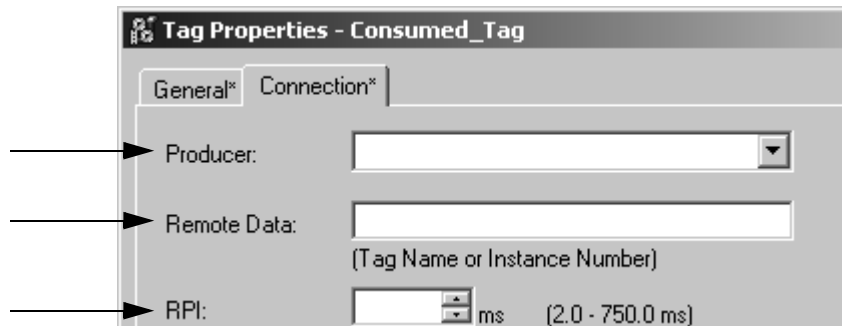
a. Under Producer, select the controller that produces the data.

b. Under Remote Data, type the tag name or instance number of the produced data.

c. Under RPI, type or select the requested packet interval (RPI) for the connection.

Set the RPI only as fast as needed by the application. The RPI also determines the number of packets per second that the module will produce on a connection. Each module has a limit of how many packets it can produce per second. If you exceed this limit, the module cannot open any more connections.

For information on RPI and how it affects the actual packet interval (API), see the EtherNet/IP Performance Application Solution, ENET-AP001.

5. Click OK.

Guidelines for MSG Instructions

Follow these guidelines.

Guideline	Details
1. For each MSG instruction, create a control tag.	Each MSG instruction requires its own control tag. • Data type = MESSAGE • Scope = controller • The tag cannot be part of an array or a user-defined data type.
2. Keep the source and/or destination data at the controller scope.	A MSG instruction can access only tags that are in the Controller Tags folder (controller scope).
3. If your MSG is to a module that uses 16-bit integers, use a buffer of INTs in the MSG and DINTs throughout the project.	If your message is to a module that uses 16-bit integers, such as a PLC-5 or SLC 500 controller, and it transfers integers (not REALs), use a buffer of INTs in the message and DINTs throughout the project. This increases the efficiency of your project because Logix5000 controllers execute more efficiently and use less memory when working with 32-bit integers (DINTs).
4. Cache the connected MSGs that execute most frequently.	Cache the connection for those MSG instructions that execute most frequently, up to the maximum number permissible for your controller revision. This optimizes execution time because the controller does not have to open a connection each time the message executes.
5. If you want to enable more than 16 MSGs at one time, use some type of management strategy.	If you enable more than 16 MSGs at one time, some MSG instructions may experience delays in entering the queue. To guarantee the execution of each message, use one of these options: • Enable each message in sequence • Enable the messages in groups • Program a message to communicate with multiple modules • Program logic to coordinate the execution of messages
6. Keep the number of unconnected and uncached MSGs less than the number of unconnected buffers.	The controller can have 10...40 unconnected buffers. The default number is 10. • If all the unconnected buffers are in use when an instruction leaves the message queue, the instruction errors and does not transfer the data. • You can increase the number of unconnected buffers (40 max.).

For more information on programming MSG instructions, see the Logix5000 Controller General Instructions Reference Manual, publication 1756-RM003.

The individual system user manuals for Logix5000 controllers also provide MSG examples unique to specific controller platforms.

Determine Connections for Messages

Messages transfer data to other modules, such as other controllers or operator interfaces. Each message uses one connection, regardless of how many modules are in the message path. To conserve connections, you can configure one message to read from or write to multiple modules.

These connected messages can leave the connection open (cache) or close the connection when the message is done transmitting. The following table shows which messages use a connection and whether or not you can cache the connection.

Message Connections

This type of message	Using this communication method	Uses a connection
CIP data table read or write	CIP	Yes
PLC2, PLC3, PLC5, or SLC (all types)	CIP	No
	CIP with Source ID	No
	DH+	Yes
CIP generic	CIP	Your choice[1]
Block-transfer read or write		Yes

[1]   You can connect CIP generic messages, but for most applications we recommend you leave CIP generic messages unconnected.

Guidelines For Caching Message Connections

If a message	Then
Executes repeatedly	Cache the connection. **Important:** Caching keeps the connection open and optimizes execution time. Opening a connection each time the message executes increases execution time.
Executes infrequently	Do not cache the connection. **Important:** Not caching closes the connection upon completion of the message, freeing up the connection for other uses.

Enter Message Logic

To send or receive data from an EtherNet/IP module via a message, you must program a MSG instruction in the local controller's logic. If the target module is configured in the I/O Configuration folder of the controller, browse to select the module or manually enter the message path in the MSG instruction.

Add the EtherNet/IP Module to the Local Controller's I/O Configuration

To use the Browse button to select the target device of a MSG instruction, add that remote device to the I/O Configuration folder of the local controller. Within the I/O Configuration folder, organize the local and remote devices into a hierarchy (tree/branch, parent/child).

For a typical local/remote MSG structure…

Local Controller	Local Communication Module		Remote Communication Module	Remote Controller
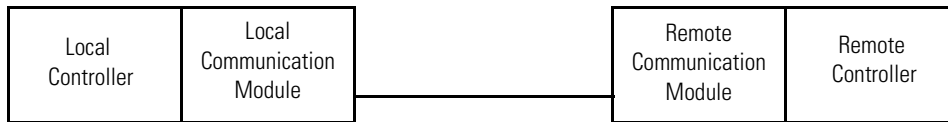
…build the I/O configuration in this order.

1. Add the local communication module for the local controller.

2. Add the remote communication module for the remote controller.

3. Add the remote controller.

```
RSLogix 5000 - MyProject_1 [1756-L61]
File   Edit   View   Search   Logic   Communications   Tools

Offline              RUN
No Forces            OK
No Edits             BAT
                     I/O

   Controller MyProject_1
   Tasks
   Motion Groups
   Trends
   Data Types
   I/O Configuration
      [1] 1756-ENBT/A Local_Comm_Module
      [0] 1756-ENBT/A Remote_Comm_Module
         [1] 1756-L61 Remote_Controller
```
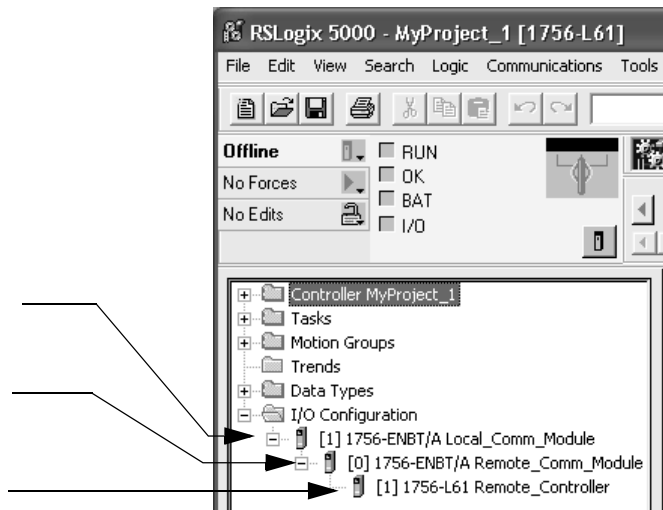
Select a communication format for a communication module based on the modules in its remote chassis.

Module Communication Formats

If	Select a communication format that specifies
The remote chassis contains only analog modules, diagnostic digital modules, fused output modules, or communication modules	None
The remote chassis only contains standard, digital input and output modules (no diagnostic modules or fused output modules)	Rack Optimization
You want to receive I/O module and chassis slot information from a rack-optimized remote chassis owned by another controller	Listen-Only Rack Optimization

Perform this procedure to add a module to the I/O Configuration folder.
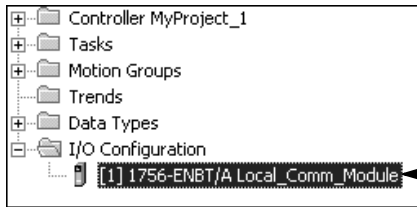
1. Right-click the required level (branch) and choose New Module.

2. Choose the module.

3. Configure the module.

To	Do This
Use the default configuration	Specify the general information about the module (name, comm format) and click Finish.
Customize the configuration	Specify the general information about the module (name, comm format). Then use the Next buttons to step through subsequent screens.

Enter a Message

Perform this procedure to enter a message.

    1. Use relay ladder logic to enter a MSG instruction.

    2. Click the button ▣ to configure the MSG instruction.

EXAMPLE   Enter a MSG instruction

If *count_send* = 1 and *count_msg.EN* = 0 (MSG instruction is not already enabled), then execute a MSG instruction that sends data to another controller.

Configure a MSG Instruction

Perform this procedure to configure a MSG instruction.

    1. Click ▣ in the MSG box.

      The Message Configuration dialog appears.

    2. Select Configuration and specify the type of MSG instruction.

Configure a MSG to a Logix5000 Controller

If you want to	For this item	Type or select
Read (receive) the data	Message Type	CIP Data Table Read
	Source Element	First element of the tag that contains data in the other controller
	Number of Elements	Number of elements to transfer
	Destination Tag	First element of the tag (controller-scoped) in this controller for the data
Write (send) the data	Message Type	CIP Data Table Write
	Source Tag	First element of the tag (controller-scoped) in this controller that contains the data
	Number of Elements	Number of elements to transfer
	Destination Element	First element of the tag for the data in the other controller

Configure a MSG to an SLC 500 Processor

If the data is	And you want to	For this item	Type or select
Integer	Read (receive) data	Message Type	SLC Typed Read
		Source Element	Data table address in the SLC 500 controller (for example, N7:10)
		Number of Elements	Number of integers to transfer
		Destination Tag	First element of int_buffer
	Write (send) data	Message Type	SLC Typed Write
		Source Tag	First Element of int_buffer
		Number of Elements	Number of integers to transfer
		Destination Element	Data table address in the SLC 500 controller (for example, N7:10)
Floating-point (REAL)	Read (receive) data	Message Type	SLC Typed Read
		Source Element	Data table address in the SLC 500 controller (for example, F8:0)
		Number of Elements	Number of values to transfer
		Destination Tag	First element of the tag (controller-scoped) in this controller for the data
	Write (send) data	Message Type	SLC Typed Write
		Source Tag	First element of the tag (controller-scoped) in this controller that contains the data
		Number of Elements	Number of values to transfer
		Destination Element	Data table address in the SLC 500 controller (for example, F8:0)

Configure a MSG to a PLC-5 Processor

If the data is	And you want to	For this item	Type or select
Integer	Read (receive) data	Message Type	PLC5 Typed Read
		Source Element	Data table address in the PLC-5 controller (for example, N7:10)
		Number of Elements	Number of integers to transfer
		Destination Tag	First element of int_buffer
	Write (send) data	Message Type	PLC5 Typed Write
		Source Tag	First element of int_buffer
		Number of Elements	Number of integers to transfer
		Destination Element	Data Table address in the PLC-5 controller (for example, N7:10)
Floating-point (REAL)	Read (receive) data	Message Type	PLC5 Typed Read
		Source Element	Data table address in the PLC-5 controller (for example, F8:0)
		Number of Elements	Number of values to transfer
		Destination Tag	First element of the tag (controller-scoped) in this controller for the data
	Write (send) data	Message Type	PLC5 Typed Write
		Source Tag	First element of the tag (controller-scoped) in this controller that contains the data
		Number of Elements	Number of values to transfer
		Destination Element	Data table address in the PLC-5 controller (for example, F8:0)

3. Select Communication and specify the communication path.

For a message to a ControlLogix controller, this RSLogix Message Configuration dialog appears.
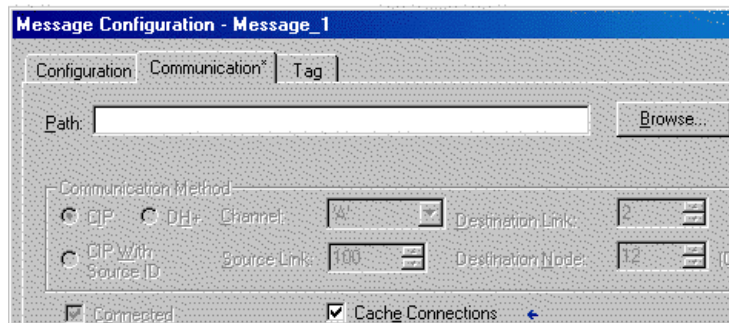
For a message to a SLC 500 or PLC-5 processor, this RSLogix Message Configuration dialog appears.
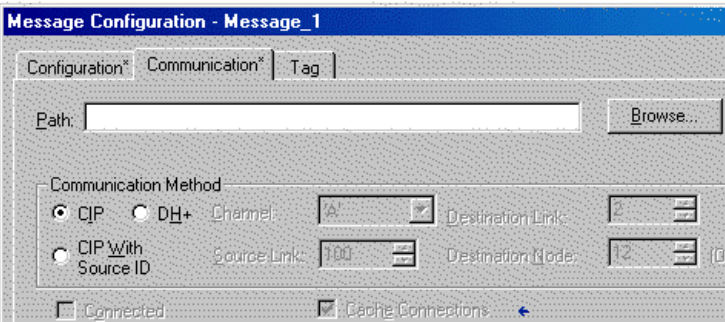
4. If the target module is configured in the I/O Configuration folder of the originating controller, click Browse to select the module or manually enter the path to the target module.

A manually entered path begins with the name of the local EtherNet/IP module, the port the message exits (2 for EtherNet/IP), and the IP address of the next module in the path, which could be the target module.

EXAMPLE   Communication path from a Logix5000 controller to a Logix5000 controller over an EtherNet/IP network
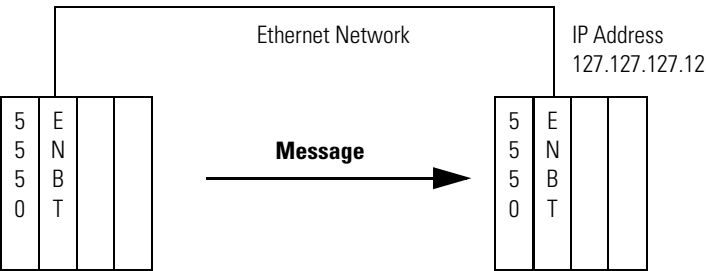
washer, 2, 127.127.127.12, 1, 0

Where	Indicates
Washer	Name of the ENBT or EN2T module
2	Ethernet port of the ENBT or EN2T module
127.127.127.12	IP address of the ENBT or EN2T module in the destination chassis
1	Backplane port of the ENBT or EN2T module in the destination chassis
0	Slot number of the destination controller

Communicate with PLC-5 or SLC Processors

If the message is to a PLC-5 or SLC 500 processor and it reads or writes integers (not REALs), use a buffer of INTs in the message.

- Logix5000 controllers execute more efficiently and use less memory when working with 32-bit integers (DINTs).
- PLC-5 and SLC 500 processors require 16-bit integers.
- Use an INT buffer in the message and move the data into or out of the buffer as needed.

Convert between INTs and DINTs

If the message is to a device that uses 16-bit integers, such as a PLC-5 or SLC 500 controller, and it transfers integers (not REALs), use a buffer of INTs in the message and DINTs throughout the project. This increases the efficiency of your project.

Read 16-Bit Integers

Data From the Device	Buffer of INTs	DINTs For Use In the Project
Word 1	INT_Buffer[0]	DINT_Array[0]
Word 2	INT_Buffer[1]	DINT_Array[1]
Word 3	INT_Buffer[2]	DINT_Array[2]
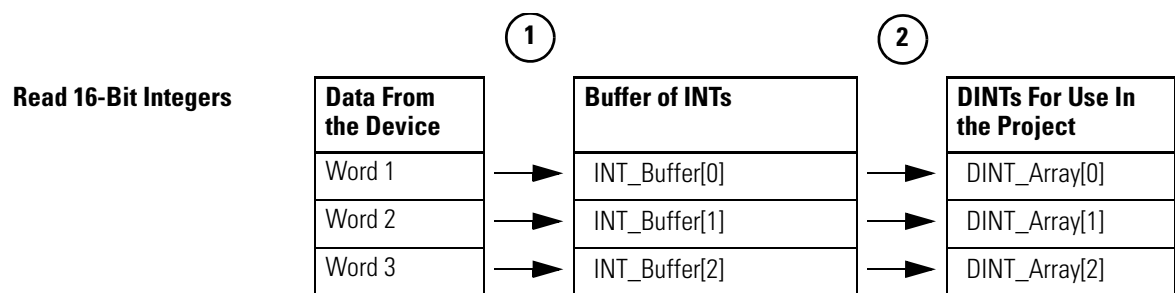
1. The Message (MSG) instruction reads 16-bit integers (INTs) from the device and stores them in a temporary array of INTs.

2. An File Arith/Logical (FAL) instruction converts the INTs to DINTs for use by other instructions in your project.

Write 16-Bit Integers

DINTs From the Project	Buffer of INTs	Data For the Device
DINT_Array[0]	INT_Buffer[0]	Word 1
DINT_Array[1]	INT_Buffer[1]	Word 2
DINT_Array[2]	INT_Buffer[2]	Word 3
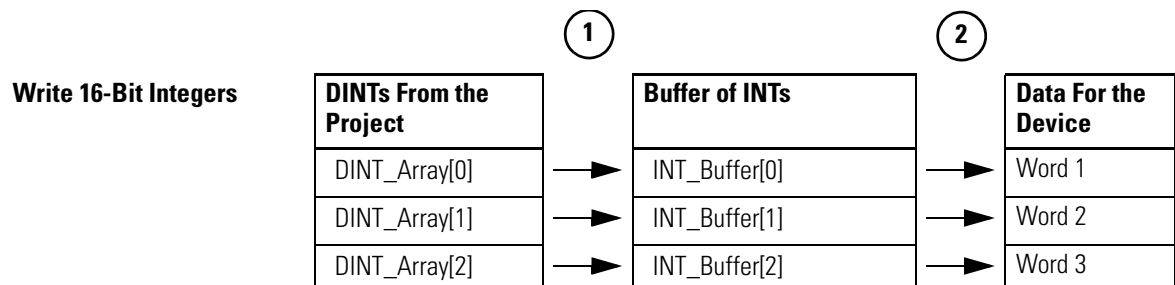
1. An FAL instruction converts the DINTs from the Logix5000 controller to INTs.

2. The MSG instruction writes the INTs from the temporary array to the device.

Map Tags

A Logix5000 controller stores tag names on the controller so that other devices can read or write data without having to know physical memory locations. Many products only understand PLC/SLC data tables, so the Logix5000 controller offers a PLC/SLC mapping function that enables you to map Logix tag names to memory locations.

- You have to map only the file numbers that are used in messages; the other file numbers do not need to be mapped.
- The mapping table is loaded into the controller and is used whenever a logical address accesses data.
- You can access only controller-scoped tags (global data).
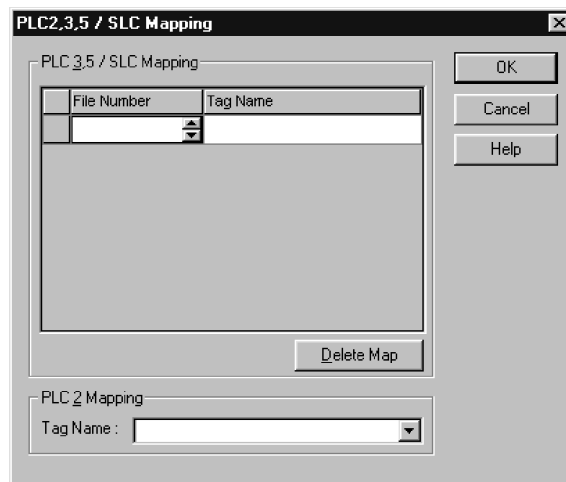
- For each file that is referenced in a PLC-5 or SLC command, make a map entry by:
  - typing the PLC/SLC file number of the logical address.
  - typing or selecting the Logix5000 controller-scoped (global) tag that supplies or receives data for the file number. (You can map multiple files to the same tag.)
- For PLC-2 commands, specify the tag that supplies or receives the data.

When mapping tags:

- do not use file numbers 0, 1, and 2. These files are reserved for Output, Input, and Status files in a PLC-5 processor.
- use PLC-5 mapping only for tag arrays of data type INT, DINT, or REAL. Attempting to map elements of system structures may produce undesirable effects.
- use the PLC file identifier of N or B when accessing elements in an INT tag array.

This example shows how to use a buffer of INTs.

EXAMPLE   Read integers from a PLC-5 controller.

When condition turns on, reads 16-bit integer values (INTs) and stores them in int_buffer. Then the FAL instruction moves the values to dint_array. This converts the values to 32-bit integers (DINTs), for use by other instructions in the ControlLogix controller.

```
condition      message.EN                                          ┌──────MSG───────┐
  ─] [─────────]/[────────────────────────────────────────────────│ Type - Unconfigured        │──(EN)
                                                                   │ Message Control    message ... │──(DN)
                                                                   │                            │──(ER)
                                                                   └────────────────┘

message.DN                                fal_control              ┌──────FAL───────┐
  ─] [──────────────────────────────────────(RES)─────────────────│ File Arith/Logical          │──(EN)
                                                                   │ Control        fal_control  │
                                                                   │ Length               ?      │──(DN)
                                                                   │ Position             0      │
                                                                   │ Mode                all     │──(ER)
                                                                   │ Dest    dint_array[fal_control.pos] │
                                                                   │                            │
                                                                   │ Expression  int_buffer[fal_control.pos] │
                                                                   └────────────────┘
```
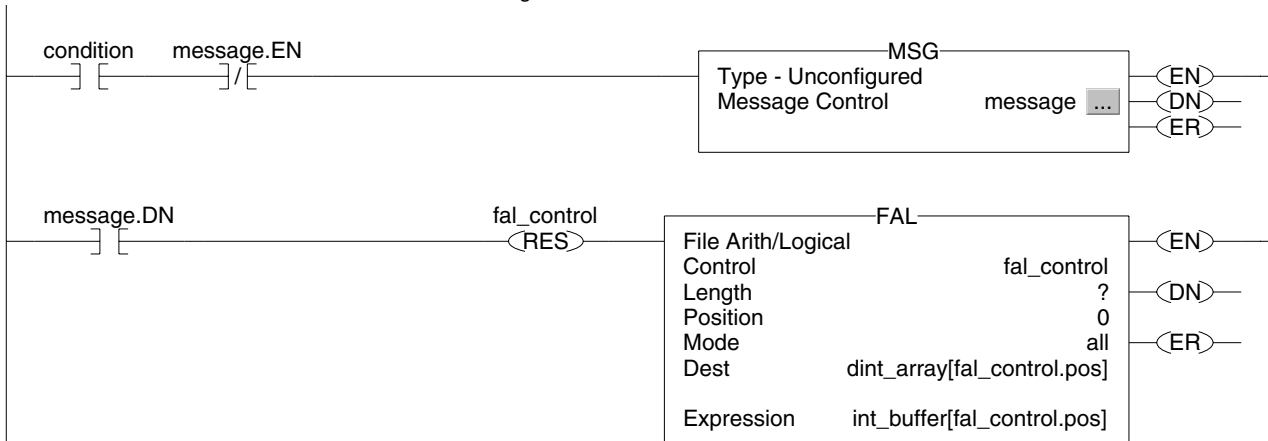
EXAMPLE   Write integers to a PLC-5 controller.

When condition turns on, moves the values in dint_array to int_buffer. This converts the values to 16-bit integers (INTs). Then the message instruction sends int_buffer to the other controller.

```
condition                          fal_control                    ┌──────FAL───────┐
  ─] [─────────────────────────────────(RES)──────────────────────│ File Arith/Logical          │──(EN)
                                                                   │ Control        fal_control  │
                                                                   │ Length               ?      │──(DN)
                                                                   │ Position             0      │
                                                                   │ Mode                all     │──(ER)
                                                                   │ Dest    int_buffer[fal_control.pos] │
                                                                   │                            │
                                                                   │ Expression  dint_array[fal_control.pos] │
                                                                   └────────────────┘

fal_control.DN   message.EN                                        ┌──────MSG───────┐
  ─] [──────────]/[─────────────────────────────────────────────── │ Type - Unconfigured        │──(EN)
                                                                   │ Message Control    message ... │──(DN)
                                                                   │                            │──(ER)
                                                                   └────────────────┘
```
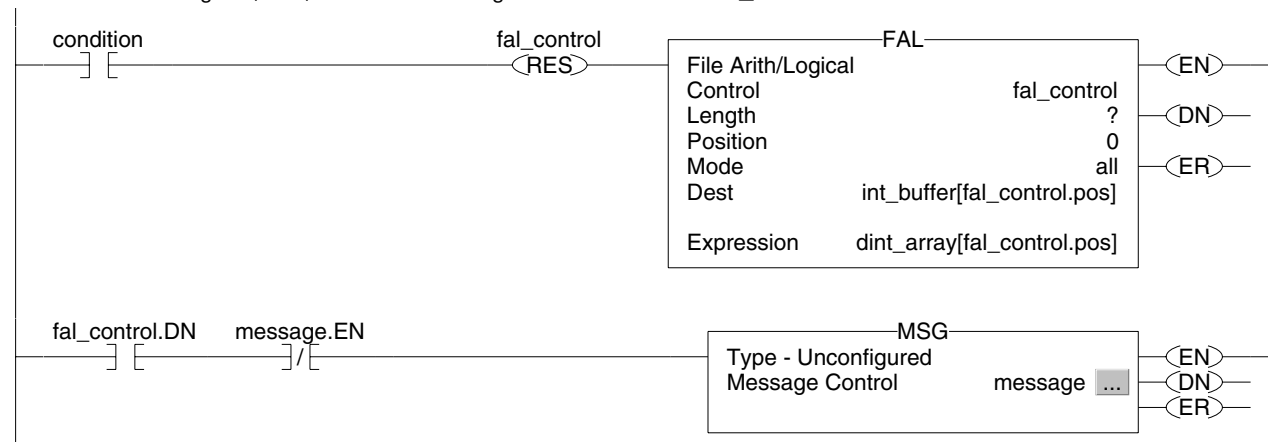
42424

Where	Is an
dint_array	Array of DINTs that are used in the ControlLogix controller
int_buffer	Array of INTs with the same number of elements as dint_array

Receive MSGs from PLC-5 or SLC 500 Processors

Perform this procedure to receive MSGs from PLC-5 or SLC 500 processors.

1. If the originating controller is a PLC-5 or SLC 500 processor, in the MSG instruction, select PLC5.

```
┌─ MSG ──────────────────┐
│ Read/Write Message       │──⟨EN⟩──
│ Type          Peer-To-Peer│
│ Read/Write          Read  │──⟨DN⟩──
│ Target Device       PLC5  │
│ Local/Remote        Local │──⟨ER⟩──
│ Control Block       N7:0  │
│ Control Block Length  93  │
│           Setup Screen    │
└──────────────────────────┘
```

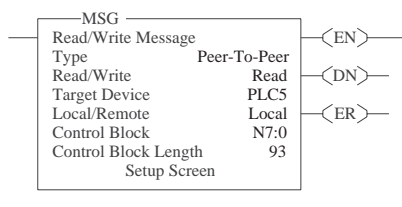| If the controller is a	For this section	And this item	Specify
PLC-5	This PLC-5	Communication Command	PLC-5 Typed Read or PLC-5 Typed Write
		Data Table Address	Starting address of the data in the PLC-5 controller
		Size in Elements	Number of elements to read or write
		Port Number	2
	Target Device	Data Table Address	Type, in quotation marks [" "], the name of the tag in the ControlLogix controller (for example, "count").
		MultiHop	Select Yes.
SLC 500	This Controller	Communication Command	PLC5 Read or PLC5 Write
		Data Table Address	Starting address of the data in the SLC 500 controller
		Size in Elements	Number of elements to read or write
		Channel	1
	Target Device	Data Table Address	Type, in quotation marks [" "], the name of the tag in the ControlLogix controller (for example, "count").
		MultiHop	Select Yes

2. On the MultiHop tab, specify:
- the IP address of the EtherNet/IP communication module that is local to the Logix5000 controller.
- the slot number of the Logix5000 controller.

Send Email

Introduction

This chapter describes how to send an email through an EtherNet/IP module.

For email, the EtherNet/IP module can be remote or local to the controller.

EtherNet/IP Module as an Email Client

The EtherNet/IP module is an email client that uses a mail relay server to send email.

IMPORTANT	The EtherNet/IP module can send an email to only one recipient at a time. It cannot mail to a distribution list.

Ethernet Email

If you want to	Then
Send an email to specific personnel when a controller application generates an alarm or reaches a certain condition	Program the controller to send a MSG instruction to the EtherNet/IP module
Send controller or application status information on a regular basis to a project manager	The MSG instruction then instructs the EtherNet/IP module to send the email text (contained within the MSG instruction) to the mail relay server.
	Multiple controllers can use the same EtherNet/IP module to initiate email.

The EtherNet/IP module sends only the content of a MSG instruction as an email to a mail relay server. Delivery of the email depends on the mail relay server. The EtherNet/IP module does not receive email.

Sample System

This device	Can
ControlLogix controller	Send a MSG instruction to the 1756-ENBT module to initiate sending an email to the mail relay server.
FlexLogix controller	
CompactLogix controller	Use the path of the MSG instruction to identify the 1756-ENBT module as the target of the MSG instruction.
1756-ENBT or 1756-EN2T module	Send an email to the mail relay server from the email interface on the Send an Email link.

This interface requires entry of all email information. |
| Mail relay server | Send email to specified recipients.

The mail relay server determines the delivery of any email sent through an EtherNet/IP module, whether via a MSG instruction or from its built-in interface. |

Send Email Via a Controller-initiated Message Instruction

A Logix controller can send a generic CIP message instruction to the EtherNet/IP module that instructs the module to send an email message to a SMTP mail relay server using the standard SMTP protocol. This automatically communicates controller data and/or application conditions to appropriate personnel.

IMPORTANT	Be careful to write the ladder logic to ensure the MSG instructions are not continuously triggered to send email messages.

Some mail relay servers require a domain name be provided during the initial handshake of the SMTP session. For these mail relay servers, specify a domain name when configuring the EtherNet/IP module's network settings.
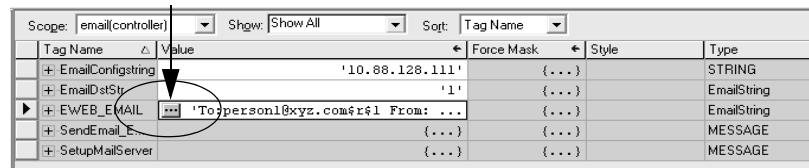
Create String Tags

You need three controller-scoped string tags. Each tag performs one of these functions:

- Identifies the mail server
- Contains the email text
- Contains the status of the email transmission

The default STRING data type supports as many as 82 characters. In most cases, this is sufficient to contain the address of the mail server. For example, to create tag EmailConfigstring of type STRING, perform this procedure.

1. Click ⬚ in the Value column to display the String Browser dialog.

2. Enter the IP address or host name of the mail server.

3. Click OK.

The tags for the email text and transmission status can contain as many as 474 characters. For these tags, you must create a user-defined STRING data type. The default STRING data type in RSLogix 5000 software is not large enough for most email text.

For example, double-click Strings and select EmailString.

4. Create a STRING data type named EmailString.

Name:	EmailString		
Description:			

Maximum Characters: 520

Members: Data Type Size: 524

	Name	Data Type	Style	Description
	LEN	DINT	Decimal	
	DATA	SINT[520]	ASCII	
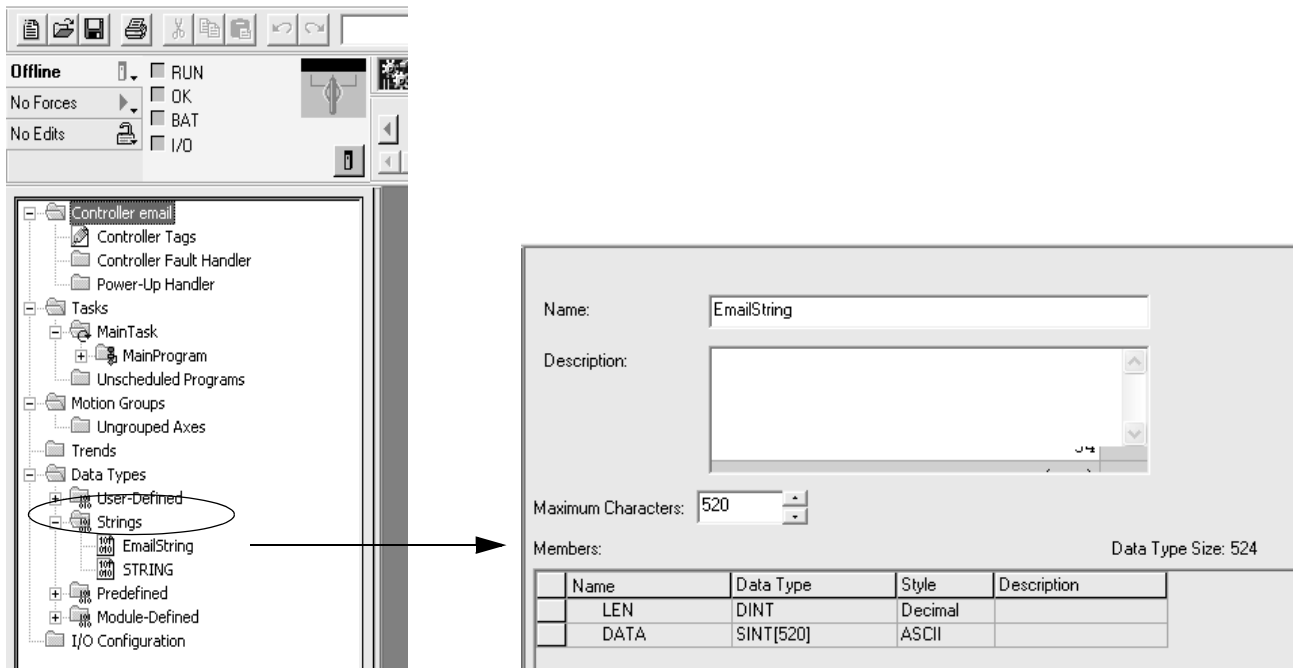
5. Create one controller-scoped tag (for example, EWEB_EMAIL) of this new data type to contain the email text.

6. Create a second controller-scoped tag (for example, EmailDstStr) of this new data type to contain the transmission status.

Both of these tags are of type EmailString.

7. Click ⬚ in the Value column to display the String Browser dialog

Scope: email(controller) Show: Show All Sort: Tag Name

Tag Name △	Value ←	Force Mask ←	Style	Type
+ EmailConfigstring	'10.88.128.111'	{...}		STRING
+ EmailDstStr	'1'	{...}		EmailString
+ EWEB_EMAIL	⬚ 'To:person1@xyz.com$r$l From: ...	{...}		EmailString
+ SendEmail_E...	{...}	{...}		MESSAGE
+ SetupMailServer	{...}	{...}		MESSAGE

Tag for Status →

Tag for Email Text →
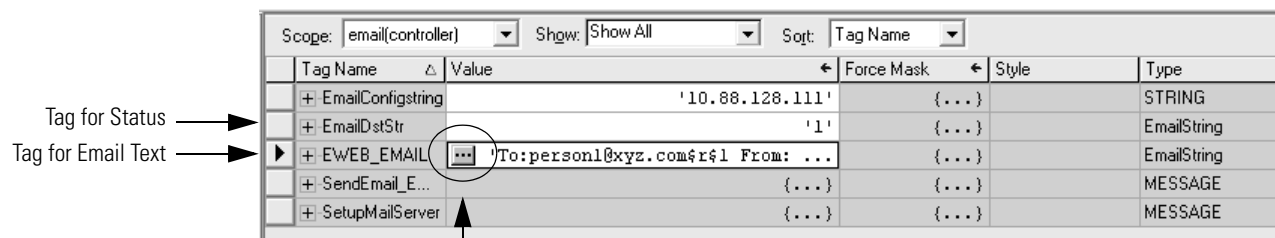
Click in the Value column to display this button. Click this button to display the String Browser so you can enter the email.

8. Enter the email.

```
String Browser - EWEB_EMAIL                          [X]

To:person1@xyz.com$r$l From:                    $$
1756EWEB@demo.COM$r$l This is a test!!          $'
$r$l                                            $L
                                                $N
                                                $P
                                                $R
                                                $T

Position: 65   Count: 65 of 520          <<  Errors  >>

   OK        Cancel        Apply         Help
```
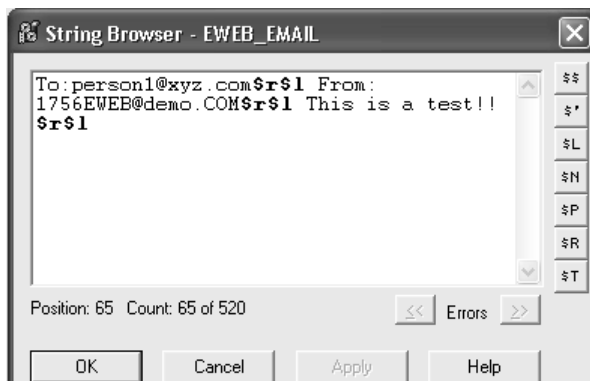
The text of the email does not have to be static. You can program a controller project to collect specific data to be sent in an email.

9. Click OK.

For more information on using ladder logic to manipulate string data, see the Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001.

Enter the Ladder Logic

Ladder logic requires two MSG instructions. One MSG instruction configures the mail server and needs to be executed only once. The second MSG instruction triggers the email. Execute this email MSG instruction as often as needed.

```
S:FS                                    ┌────────MSG─────────┐
─┤ ├─                                   │ Type - CIP Generic │──(EN)─
                                        │ Message Control    │  SetupMailServer  [...]  ─(DN)─
                                        │                    │──(ER)─
                                        └────────────────────┘

trigger                                 ┌────────MSG─────────┐
─┤ ├─                                   │ Type - CIP Generic │══(EN)═
                                        │ Message Control    │  SendEmail_EWEB   [...]  ═(DN)═
                                        │                    │──(ER)─
                                        └────────────────────┘
```
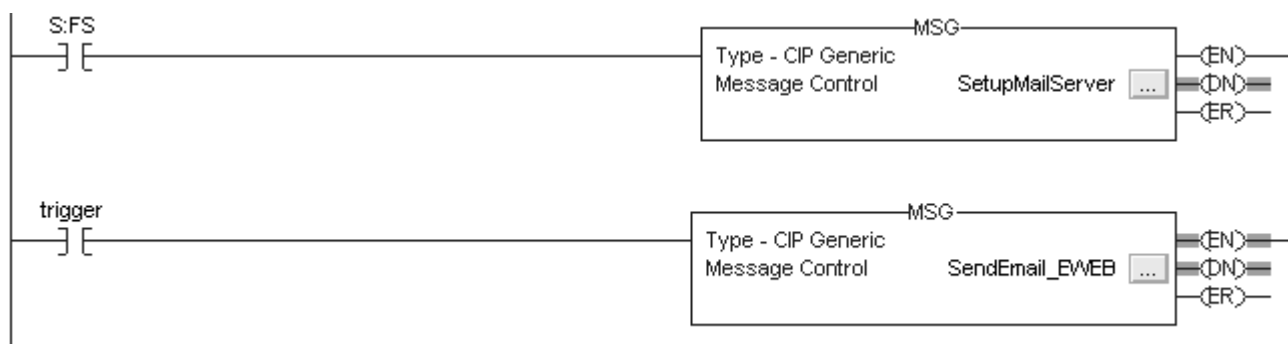
The first rung configures the mail server. The second rung sends the email text.

Configure the MSG Instruction That Identifies the Mail Relay Server

To configure the MSG instruction that identifies the mail relay server, perform this procedure.

1. On the Communication tab of the MSG instruction, configure the path for the MSG instruction.
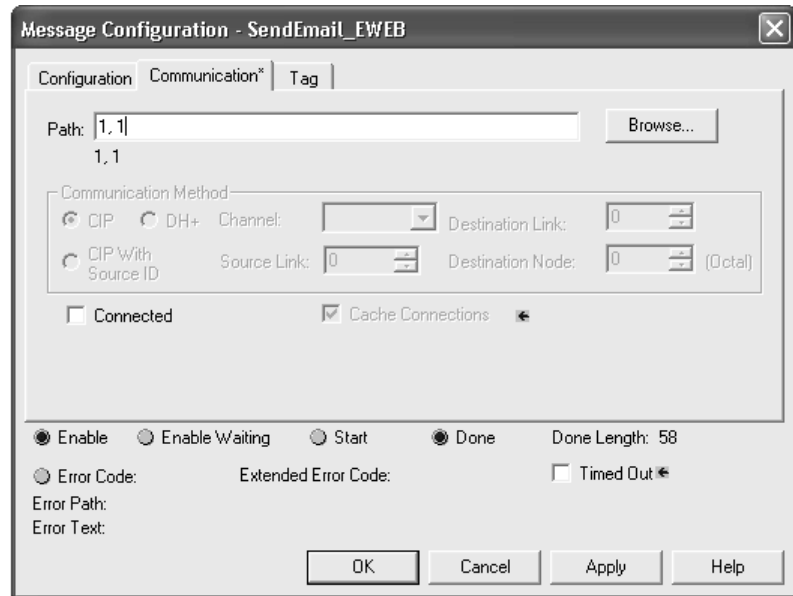
The path starts with the controller initiating the MSG instruction.

2. Enter the number of the port from which the message exits and the address of the next module in the path.

For example, if the EtherNet/IP module is in the same chassis as the controller and is in slot 2, the path is: 1, 2.

For more information on configuring the path of a MSG instruction, see the Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003.

3. On the Communication tab of the MSG instruction, configure the MSG parameters for identifying the mail relay server.

Some mail relay servers require a domain name during the initial handshake of the SMTP session.

4. For these mail relay servers, specify a domain name when configuring the EtherNet/IP module's network settings

The Source Length is the number of characters in the STRING tag that identifies the mail relay server plus 4 characters.

In this example, the tag contains 13 characters.

```
Message Configuration - SetupMailServer                              [X]

 Configuration | Communication | Tag |

   Message Type:        CIP Generic                          [v]

   Service     Set Attribute Single      [v]    Source Element:  EmailConfigstring  [v]
   Type:
                                                 Source Length:   17    [±]   (Bytes)
   Service   10    (Hex)  Class:  32f   (Hex)   Destination
   Code:                                                              [v]
   Instance: 1          Attribute: 5   (Hex)
                                                          New Tag...


   O Enable    O Enable Waiting    O Start    ● Done    Done Length: 0
   O Error Code:            Extended Error Code:          □ Timed Out ⇍
   Error Path:
   Error Text:
                            OK      Cancel      Apply      Help
```

where:

In this field	Enter
Service Type	Set Attribute Single
Instance	1
Class	32f
Attribute	5
Source Element	The STRING tag that contains the IP address or host name of the mail relay server In this example, enter EmailConfigstring
Source Length	The number of characters in the IP address or host name of the mail server plus 4 In this example, enter 17 (13 characters in the IP address 10.88.128.111 + 4)

After the MSG instruction that configures the mail relay server executes successfully, the controller stores the mail relay server information in non-volatile memory. The controller retains this information, even through power cycles, until another MSG instruction changes the information.

Configure the MSG Instruction That Contains the Email Text

To configure the MSG instruction that contains the email text, perform this procedure.

1. On the Communication tab of the MSG instruction, configure the path for the MSG instruction.

2. On the Configuration tab of the MSG instruction, configure the MSG parameters for sending an email.

The Source Length is the number of characters in the email tag plus 4 characters.

In this example, the email text contains 65 characters.

```
Message Configuration - SendEmail_EWEB

Configuration | Communication | Tag |

Message Type:        CIP Generic

Service   Custom                    Source Element:  EWEB_EMAIL
Type:
                                    Source Length:   69      (Bytes)
Service   4b    (Hex)  Class:  32f  (Hex)  Destination   EmailDstStr
Code:
Instance: 1           Attribute: 0 (Hex)
                                    New Tag...

● Enable    ○ Enable Waiting    ○ Start    ● Done    Done Length: 58
○ Error Code:          Extended Error Code:        ☐ Timed Out ⬸
Error Path:
Error Text:
                                    OK    Cancel    Apply    Help
```

where:

In this field	Enter
Service Type	Custom
Service Code	4b
Instance	1
Class	32f
Attribute	0
Source Element	The tag that contains the email text This tag is of the STRING data type created to contain the email text. In this example, enter EWEB_EMAIL which is of type EmailString.
Source Length	The number of characters in the email text plus 4 In this example, enter 69 (65 characters in the email + 4).
Destination	A tag to contain the status of the email transmission This tag is also of the STRING data type created to contain the email text. In this example, enter EmailDstStr which is of type EmailString.

3. On the Communication tab of the MSG instruction, configure the path from the controller to the EtherNet/IP module.
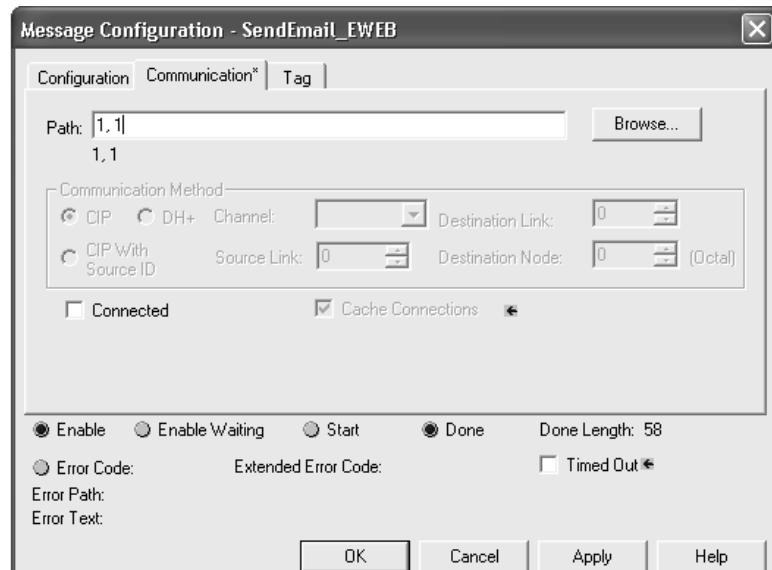
The path starts with the controller initiating the MSG instruction.

4. Then enter the number of the port from which the message exits and the address of the next module in the path.

For example, if the EtherNet/IP module is in the same chassis as the controller and is in slot 2, the path is: 1, 2.

5. If all the devices in the path are configured in the initiating controller's I/O Configuration tree, click Browse to select the target module.

The software automatically fills in the path.

For more information on configuring the path of an MSG instruction, see the Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003.

Enter Email Text

Use the string browser to enter the text of the email. In the same example, enter the email text into the EWEB_EMAIL tag. To include "To:", "From:", and "Subject:" fields in the email, use <CR><LF> symbols to separate each of these fields. The "To:" and "From"" fields are required; the "Subject:" field is optional. Use a second set of <CR><LF> symbols after the last one of these fields you enter. For example:

To: email address of recipient rl
From: email address of sender$r$l

Subject: subject of message rlrl
body of email message

The maximum length of an email message is 474 characters. An
additional 4-byte string-length value is added to the tag. As a result,
the maximum source length is 478 characters.

Possible Email Status Codes

Examine the destination element of the email MSG to see whether the
email was successfully delivered to the mail relay server. This
indicates that the mail relay server placed the email message in a
queue for delivery. It does not mean the intended recipient
successfully received the email message. These are the possible codes
that could be in this destination element.

Error Code (Hex)	Extended-error Code (Hex)	Description
0x00	None	Delivery successful to the mail relay server.
0x02	None	Resource unavailable. The email object was unable to obtain memory resources to initiate the SMTP session.
0x08	None	Unsupported Service Request. Make sure the service code is 0x4B and the Class is 0x32F.
0x11	None	Reply data too large. The Destination string must reserve space for the SMTP server reply message. The maximum reply can be 470 bytes.
0x13	None	Configuration data size too short. The Source Length is less than the Source Element string size plus the 4-byte length. The Source Length must equal the Source Element string size + 4.
0x15	None	Configuration data size too large. The Source Length is greater than the Source Element string size plus the 4-byte length. The Source Length must equal the Source Element string size + 4.
0x19	None	Data write failure. An error occurred when attempting to write the SMTP server address (attribute 4) to non-volatile memory.
0xFF	0x0100	Error returned by email server; check the Destination string for reason. The email message was not queued for delivery.
	0x0101	SMTP mail server not configured. Attribute 5 was not set with a SMTP server address.
	0x0102	"To:" address not specified. Attribute 1 was not set with a "To:" address AND there is not a "To:" field header in the email body.
	0x0103	"From:" address not specified. Attribute 2 was not set with a "From:" address AND there is not a "From:" field header in the email body.
	0x0104	Unable to connect to SMTP mail server set in Attribute 5. If the mail server address is a host name, make sure that the device supports DNS, and that a Name Server is configured. If the hostname is not fully qualified, for example, "mailhost" and not "mailhost.xx.yy.com" then the domain must be configured as "xx.yy.com". Try "ping <mail server address>" to insure the mail server is reachable from your network. Also try "telnet <mail server address> 25" which attempts to initiate a SMTP session with the mail server via telnet over port 25. (If you connect then enter "QUIT").
	0x0105	Communication error with SMTP mail server. An error occurred after the initial connection with the SMTP mail server. See the ASCII text following the error code for more details as to the type of error.
	0x0106	SMTP mail server host name DNS query did not complete. A previous send service request with a host name as the SMTP mail server address did not yet complete. Note that a timeout for a DNS lookup with an invalid host name can take up to 3 minutes. Long timeouts can also occur if a domain name or name server is not configured correctly.

Communicate with PanelView Terminals

Introduction

This chapter describes how a controller uses an EtherNet/IP communication module to communicate with PanelView and PanelView Plus terminals over an EtherNet/IP network.

Topic	Page
Set Up the Hardware	81
Determine Connections to PanelView Terminals	82
Add a PanelView Terminal	83
Organize Controller Data for a PanelView Terminal	86
Determine Connections to RSView Applications	86

Set Up the Hardware

In this example, the controller in the local chassis shares data with an HMI application on the EtherNet/IP network. This application could be running any of the following:

- PanelView terminal
- PanelView Plus terminal
- Workstation running an RSView 32 software
- Workstation running an RSView Enterprise application, such as RSView Machine Edition or RSView Supervisory Edition

Ethernet Communication with Panelview
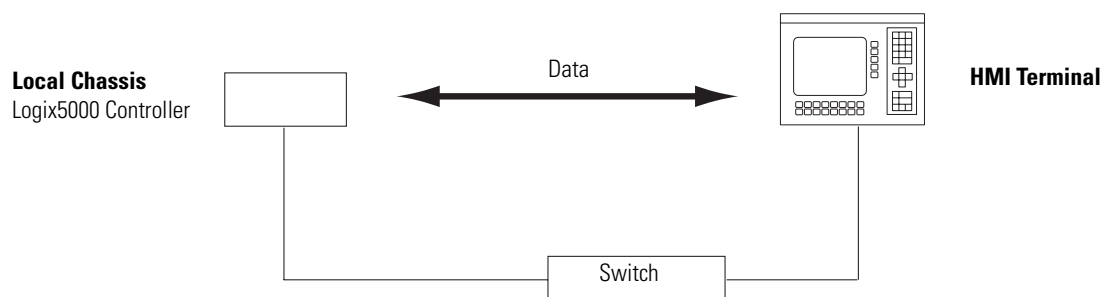
Logix5000 Controller Combinations

These controllers	Can combine with
1756 ControlLogix	1756-ENBT or 1756-EN2T communication module.
1768 CompactLogix	1768-ENBT communication module.
1769-L35E CompactLogix	A built-in EtherNet/IP port.
1794 FlexLogix	1788-ENBT EtherNet/IP communication module.
PowerFlex 700S with DriveLogix	1788-ENBT EtherNet/IP communication module.

Make sure to:

- set the IP addresses for the controller's EtherNet/IP communication module and the HMI terminal.
- connect all wiring and cabling.

Determine Connections to PanelView Terminals

To establish communication between a PanelView or PanelView Plus terminal, specify controller connections.

	Terminal Type	
Type of Communication	**PanelView**	**PanelView Plus**
Implicit (connected) • Logix controller communicates to the PanelView terminal like an I/O module • You must add the PanelView terminal to the I/O configuration tree for the controller project	Supported	Not supported
Explicit (unconnected) • Communications are set up in PanelBuilder or RSView ME Software • All communications are initiated by the PanelView or PanelView Plus terminal	Supported	Supported

When communicating implicitly (PanelView terminals only), the controller uses one connection for each terminal. Make sure to account for these connections when designing the system. The Logix5000 controllers:

- firmware revisions 11 and earlier support as many as 16 bidirectional implicit buffers (connections).
- firmware revisions 12 or later support as many as 32 bidirectional implicit buffers (connections).

The larger number of implicit buffers enables significantly more PanelView terminals to simultaneously request data from the controller via implicit communications.

When communicating explicitly, the controller supports 40 outgoing and 3 incoming buffers. This number of incoming buffers limits how many terminals can simultaneously request data from a controller via explicit communications. In other words, while a system can have multiple terminals, only three terminals can explicitly request data from a Logix controller at the same time.
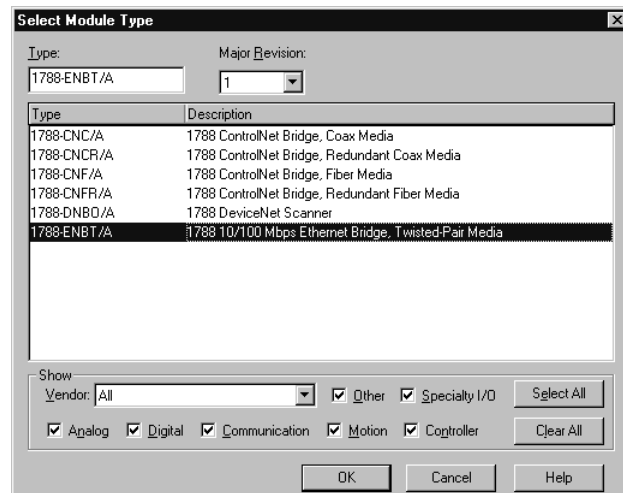
Add a PanelView Terminal

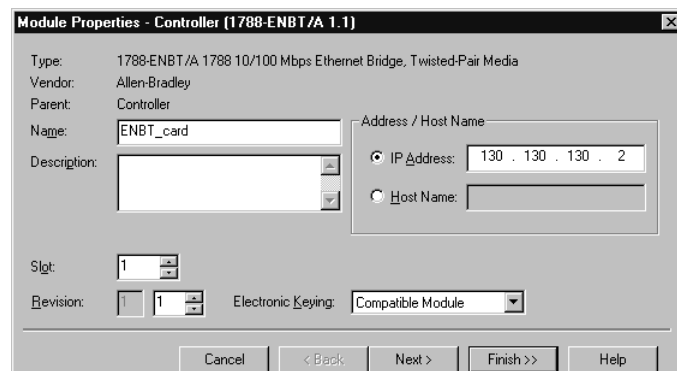To add a Panelview terminal, perform this procedure.

1. In the Controller Organizer of the RSLogix 5000 programming software, right-click I/O Configuration to select New Module.
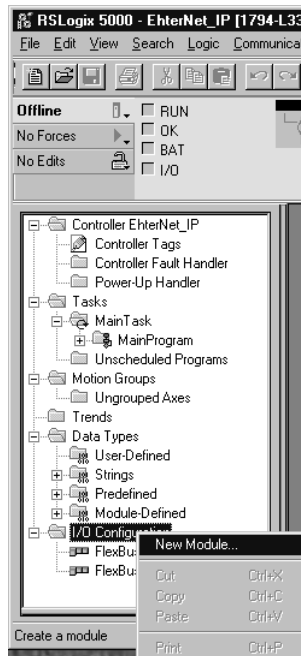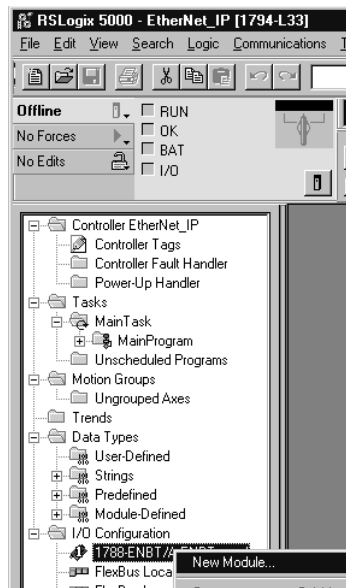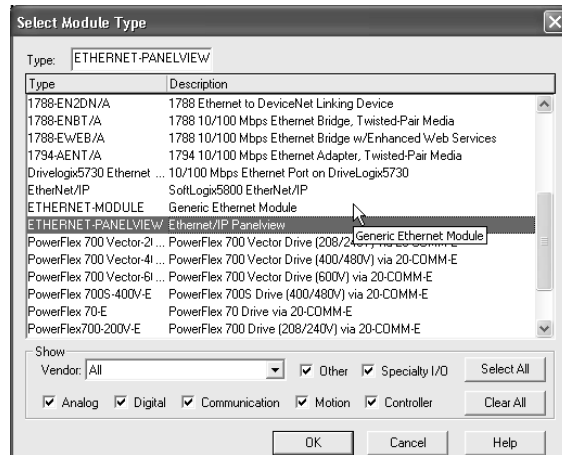
2. Add the local EtherNet/IP communication module.

3. Click OK.

4. Configure the local EtherNet/IP communication module.
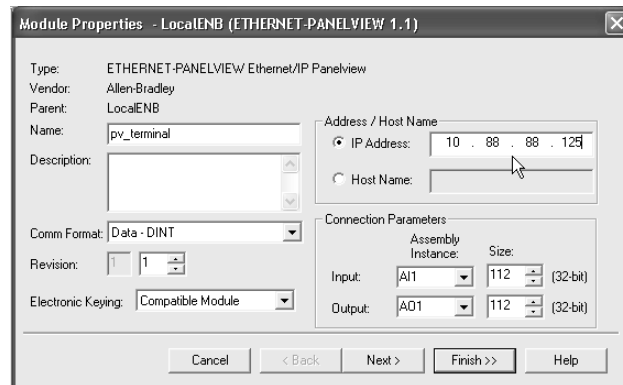

5. Select the local EtherNet/IP communication module.

6. Right-click to select New Module, and add an ETHERNET-PANELVIEW.

7. Click OK.

8. Configure the terminal.

In this field	Do this
Comm Format	Select Data - DINT.
Connection Parameters	Specify the input and output instances for this terminal. You can establish up to eight different instances with each terminal. For example, one controller can use all eight instances. Or eight controllers can each use one instance.

Organize Controller Data for a PanelView Terminal

Organize data for a PanelView terminal based on how the data is used.

For data that is	Do this
Time critical (for example, data that controls a machine)	Use the I/O tags of the terminal. The tags for this data were created when you added the terminal to the I/O configuration of the controller. They resemble the I/O modules' tags.
Not time critical	Create arrays to store the data. 1. For each screen, create a BOOL array with enough elements for the bit-level objects on the screen. For example, the BOOL[32] array gives you 32 bits for push buttons or indicators. 2. For each screen, create a DINT array with enough elements for the word-level objects on the screen. For example, the DINT[28] array, give you 28 values for numeric entry controls or numeric displays.

To access the I/O tags of the PanelView or PanelView Plus terminal, use the following address format:

If the terminal	Use this address
Writes the data	name_of_terminal:I.Data[x].y
Reads the data	name_of_terminal:O.Data[x].y

where:

This address variable	Is
name_of_terminal	Name of the instance in the I/O configuration of the controller
x	Element of the input (I) or output (O) structure.
y	Bit number within the input or output element

Determine Connections to RSView Applications

To establish communication to an RSView application, configure RSLinx software to collect tags from the controller. An RSView 32 or RSView Enterprise application use RSLinx software as a data server.

RSLinx Enterprise software defaults to 4 read connections and 1 write connection per configured controller. Modify the RSLinx configuration as needed.

Monitor Diagnostics

Introduction

The EtherNet/IP communication modules provide several levels of diagnostics. There are user-oriented diagnostics, as well as more detailed diagnostics for technical support personnel. This chapter describes the diagnostics presented on the user-oriented diagnostic pages.

| Topic	Page
About Module Diagnostics Web Pages	87
About Module Diagnostics	88
About Network Settings	91
About Explicit Message Connections	93
About I/O Connections	94
About Ethernet Statistics	95

About Module Diagnostics Web Pages

The EtherNet/IP modules provide pages of user-oriented diagnostics. This information is organized into these Web pages.

For this information	Access this Web page
Overview of the current configuration of the module	Diagnostics →Diagnostic Overview
Summary of the network settings configured for the module	Diagnostics →Network Settings
Statistics about messages initiated by the module and their associated connections	Diagnostics →Message Connections
Statistics about I/O modules associated with the module	Diagnostics →I/O Connections
Ethernet statistics	Diagnostics →Ethernet Statistics

About Module Diagnostics

The Diagnostics →Diagnostic Overview page presents a summary of the current configuration and overall status of the module.
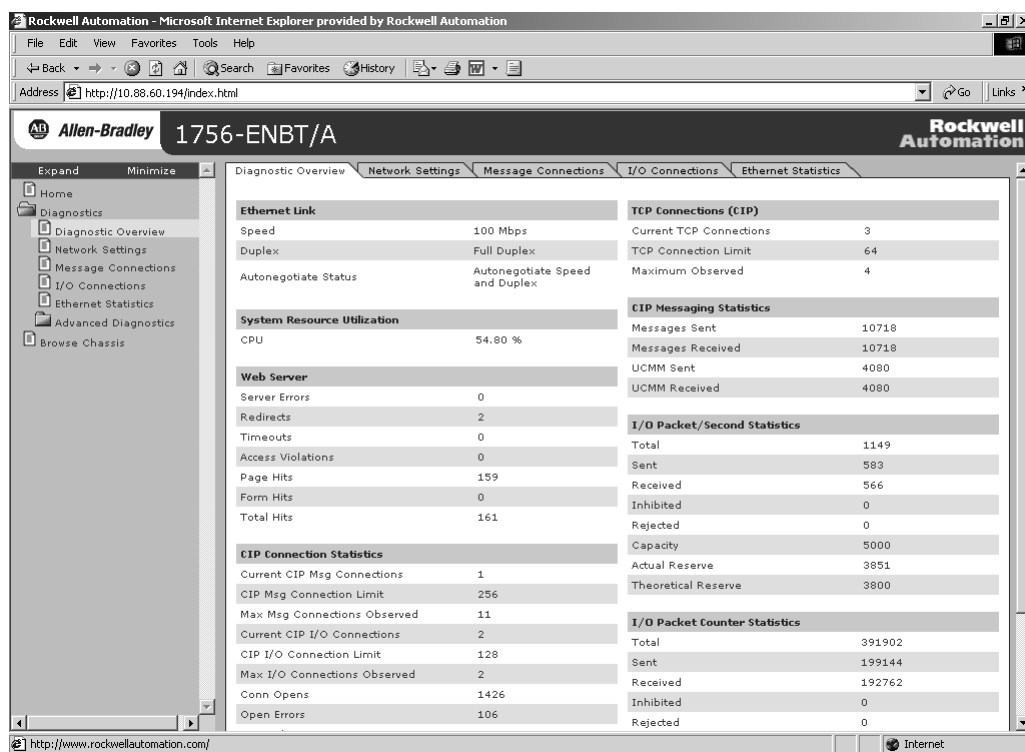
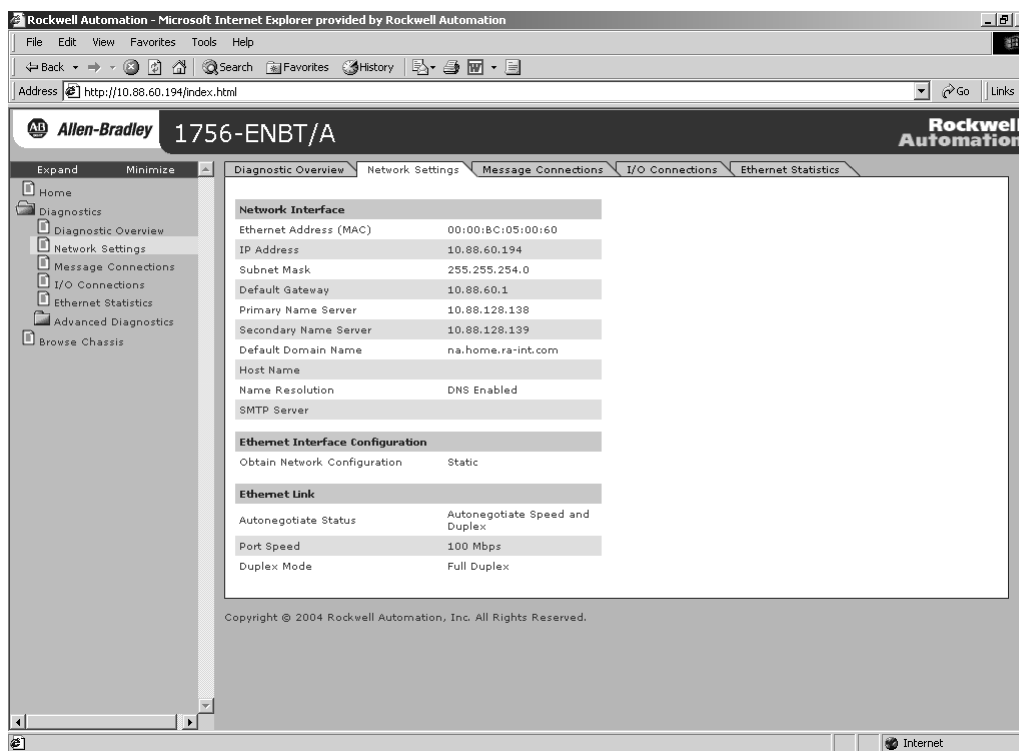| This field	Specifies
Ethernet Link	
Speed	Whether the Ethernet port is operating at 10 Mbps or 100 Mbps.
Duplex	Whether the Ethernet port is operating at half duplex or full duplex.
Autonegotiate Status	Whether the port speed and duplex mode were determined via autonegotiation or manual configuration.
System Resource Utilization	
CPU	Current percent CPU utilization for the module.
Web Server	
Server Errors	Number of requests to the module with an invalid URL.
Redirects	Number of requests for a Web page that were redirected by the module (for example, requesting "/" is redirected to "/index.html").
Timeouts	Number of times a connection timeout occurred while processing a Web page.
Access Violations	Number of times a page has been requested for which the user has insufficient privilege.
Page Hits	Number of times a Web page was successfully accessed.
Form Hits	Number of times a Web page form was accessed.
Total Hits	Total number of Web page access attempts.

This field	Specifies
CIP Connection Statistics	
Current CIP MSG Connections	Current number of CIP connections for message.
CIP MSG Connection Limit	Maximum number of CIP connections for messages allowed.
Max MSG Connections Observed	Maximum observed number of CIP connections for messages.
Current CIP I/O Connections	Current number of CIP connections for I/O.
CIP I/O Connection Limit	Maximum number of CIP connections allowed for I/O.
Max I/O Connections Observed	Maximum observed number of CIP connections for I/O.
Conn Opens	Number of CIP connection open requests.
Open Errors	Number of CIP connection open request errors.
TCP Connections (CIP)	
Current TCP Connections	Current number of active TCP connections for CIP messaging.
TCP Connection Limit	Maximum number of TCP connections for CIP messaging allowed.
Maximum Observed	Maximum observed number of TCP connections for CIP messaging.
CIP Messaging Statistics	
Messages Sent	Number of CIP connected messages (packets) sent.
Messages Received	Number of CIP connected messages (packets) received.
UCMM Sent	Number of CIP unconnected messages (packets) sent.
UCMM Received	Number of CIP unconnected messages (packets) received.
I/O Packet / Second Statistics	
Total	Total number of Class 1 UDP packets the module transmitted and received in the last one-second snapshot. The Total is the sum of the Sent, Received, Inhibited, and Rejected numbers.
Sent	Number of Class 1 UDP packets the module transmitted in the last one-second snapshot.
Received	Number of Class 1 UDP packets the module received in the last one-second snapshot.
Inhibited	Number of Class 1 UDP packets the module inhibited in the last one-second snapshot. Packets are inhibited if a COS module produces packets faster than 1/4 of the connection's RPI.
Rejected	Number of Class 1 UDP packets the module rejected in the last one-second snapshot. These packets were messages received and then rejected because the connection was closed or there was a duplicate multicast address.
Capacity	Number of Class 1 UDP packets the module can handle over the Ethernet network at any time.
Actual Reserve	Actual Reserve = Capacity - Total. This is based on the total of number packets the module has transmitted/received in the last one-second snapshot.
Theoretical Reserve	Theoretical Reserve = Capacity - the sum of the theoretical packet/second of all connections based on the RPI.

This field	Specifies
I/O Packet Counter Statistics	
Total	Cumulative number of Class 1 UDP packets the module transmitted/received.
	The Total is the sum of the Sent, Received, Inhibited, and Rejected numbers.
Sent	Cumulative number of Class 1 UDP packets the module transmitted.
Received	Cumulative number of Class 1 UDP packets the module received.
Inhibited	Cumulative number of Class 1 UDP packets the module inhibited.
	Packets are inhibited if a COS module produces packets faster than 1/4 of the connection's RPI.
Rejected	Cumulative number of Class 1 UDP packets the module rejected.
	These packets were messages received and then rejected because the connection was closed or there was a duplicate multicast address.
Missed	Cumulative number packets that were not received in order.
	Each UDP packet has a sequence number and if a packet is missing (corrupted or dropped), the module will recognize this void upon receipt of the next packet received.

A CIP connection transfers data from one Logix application running on one end-node to a second Logix application running on another end-node. A CIP connection is established over a TCP connection.

About Network Settings

The Diagnostics→Network Settings page presents a summary of the current Ethernet configuration for the module.


Any unconfigured fields remain blank.

This field	Specifies
Network Interface	
Ethernet Address (MAC)	Ethernet (MAC) address of the module.
IP Address	IP address for the module.
Subnet Mask	Subnet mask for the module.
Default Gateway	Gateway address for the module.
Primary Name Server	Primary name server.
Secondary Name Server	Secondary name server.
Default Domain Name	Default domain name for the module.
Host Name	Host name for the module.
Name Resolution	Whether or not Domain Name System (DNS) resolution is enabled.
SMTP Server	SMTP server address for the module (required for email).

This field	Specifies
Ethernet Interface Configuration	
Obtain Network Configuration	Whether the module is configured to obtain its network parameters (IP address) via BOOTP, DHCP, or from static configuration.
Ethernet Link	
Autonegotiate Status	Whether the Ethernet port is operating at 10 or 100 MBps.
Port Speed	Whether the Ethernet port is operating at half duplex or full duplex.
Duplex Mode	Whether the port speed and duplex mode were determined via autonegotiation or manual configuration.

## About Explicit Message Connections

The Diagnostics→Message Connections page presents a summary of messages bridged through or initiated by the module.
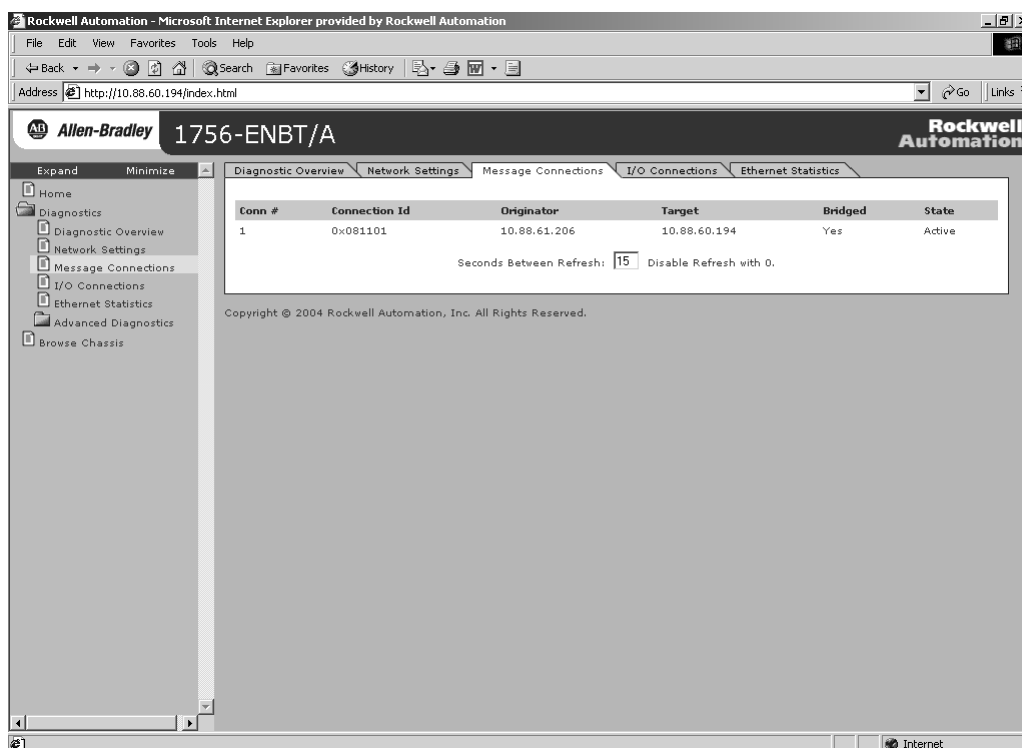
This field	Specifies
Conn #	The relative index of this connection (on the Message Connections page).
Connection ID	The unique identifier for each connection.
Originator	The IP address of the device that originated the connection on Ethernet network.
Target	The IP address of the device that is the target of the connection on Ethernet. This may not be the ultimate target of the connection (for example, the target could be a Logix controller in a chassis).
Bridged	Whether the connection bridges through the module.
State	The current state of the connection: • Active • Closing • Faulted • Reserved

About I/O Connections

The Diagnostics→I/O Connections page presents a summary of I/O connections initiated by the module.
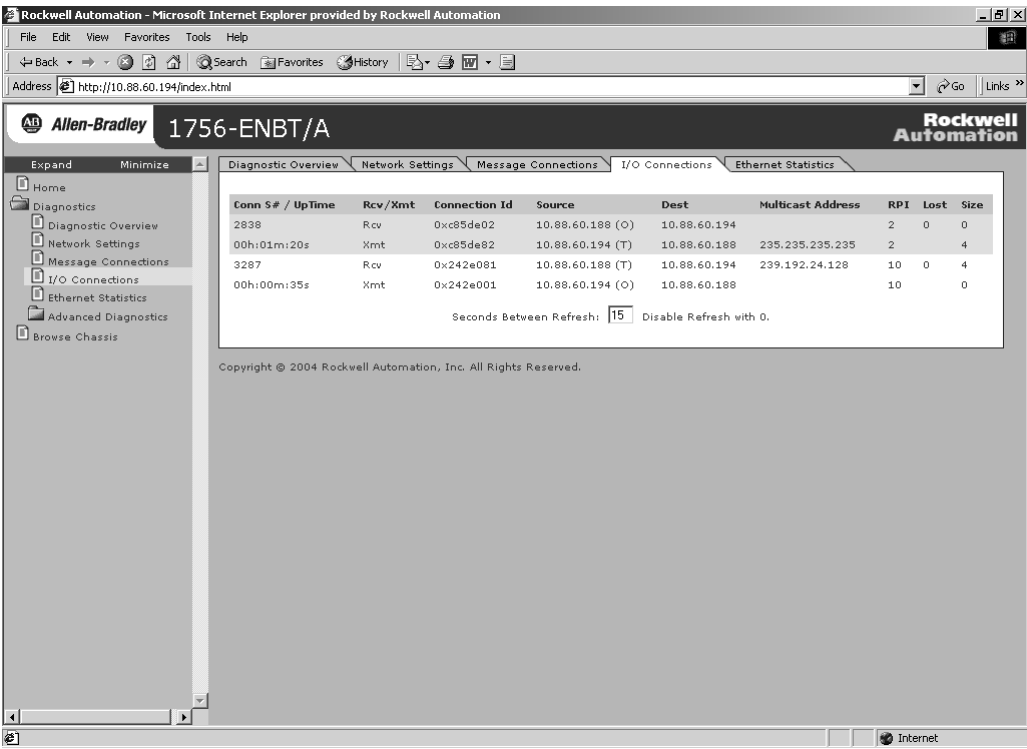
Each Class 1 UDP connection has a receive/transmit (Rcv/Xmt) pair of data and heartbeat. The originator of a connection listens on the multicast address to receive the data. The target of the connection receives the heartbeat.

In this example, the Web page is for the module at address 10.88.60.194. This module (10.88.60.194) originated a connection to 10.88.60.188 with an RPI of 10.

This field	Specifies
Conn S#/Up Time	Connection serial number and the elapsed time the connection has been maintained.
Rcv/Xmt	Connection was received or transmitted from this source address.
Connection ID	Connection identifier.
Source	IP address of the Rcv/Xmt packet. (T) = target; (O) = originator.
Dest	Destination address.
Multicast Address	Connection targets produce at this multicast address. Connection originators listen on this multicast address.

This field	Specifies
RPI	Programmed connection RPI.
Lost	Total number of packets received where the Common Packet Encapsulation sequence number is less than the last received on this connection.
Size	Size of class 1 UDP packet data (in bytes).

About Ethernet Statistics

The Diagnostics→Ethernet Statistics page presents a summary of the status of communication activity on the Ethernet network.
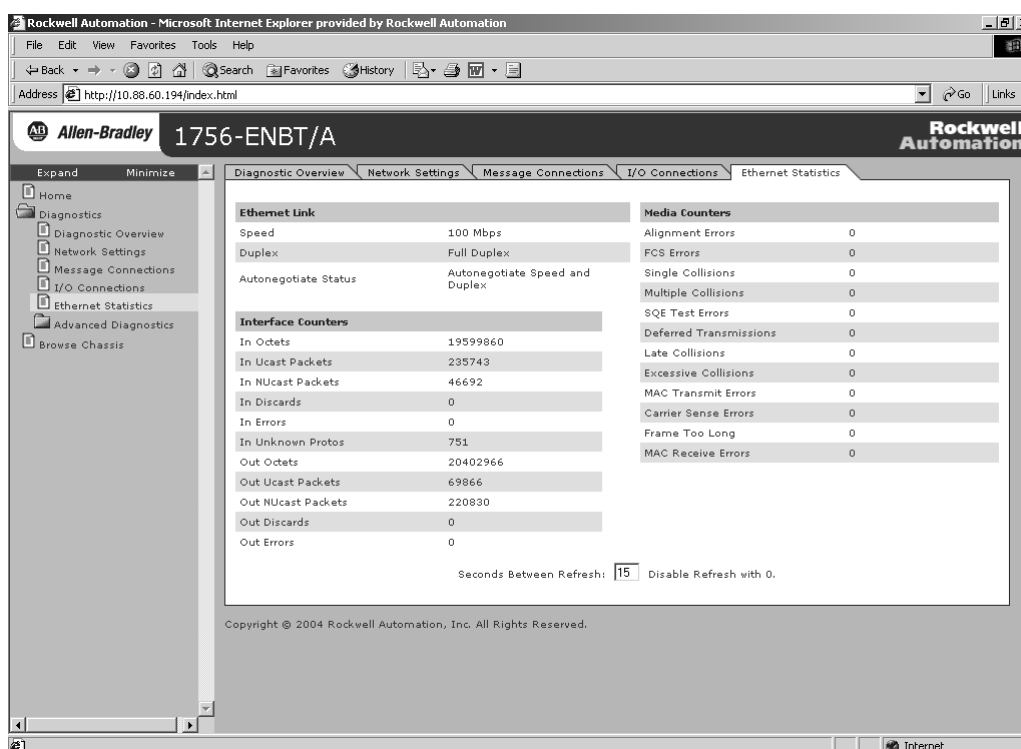
This field	Specifies
Ethernet Link	
Speed	Whether the Ethernet port is operating at 10 or 100 MBps.
Duplex	Whether the Ethernet port is operating at half duplex or full duplex.
Autonegotiate Status	Whether the port speed and duplex mode were determined via autonegotiation or whether they were manually configured.
Interface Counters	
In Octets	Octets received on the Ethernet interface.
In Ucast Packets	Unicast packets received on the Ethernet interface.
In NUcast Packets	Nonunicast packets received on the Ethernet interface.
In Discards	Inbound packets received on the Ethernet interface but discarded.

This field	Specifies
In Errors	Inbound packets that contain errors (does not include In Discards).
In Unknown Protos	Inbound packets with unknown protocol.
Out Octets	Octets sent on the Ethernet interface.
Out Ucast Packets	Unicast packets sent on the Ethernet interface.
Out NUcast Packets	Nonunicast packets sent on the Ethernet interface.
Out Discards	Outbound packets discarded.
Out Errors	Outbound packets that contain errors.
Media Counters	
Alignment Errors	Frames received that are not an integral number of octets in length.
FCS Errors	Frames received that do not pass the FCS check.
Single Collisions	Successfully transmitted frames that experienced exactly one collision.
Multiple Collisions	Successfully transmitted frames that experienced more than one collision.
SQE Test Errors	Number of times SQE test error message is generated.
Deferred Transmissions	Frames for which first transmission attempt is delayed because the medium is busy.
Late Collisions	Number of times a collision is detected later than 512 bit-times into the transmission of a packet.
Excessive Collisions	Frames for which transmission fails due to excessive collisions.
MAC Transmit Errors	Frames for which transmission fails due to an internal MAC sublayer transmit error.
Carrier Sense Errors	Times that the carrier sense condition was lost or never asserted when attempting to transmit a frame.
Frame Too Long	Frames received that exceed the maximum permitted frame size.
MAC Receive Errors	Frames for which reception on the Ethernet interface failed due to an internal MAC sublayer receive error.

USB Port Connection

Introduction

This chapter describes how to connect to the 1756-EN2T EtherNet/IP module via a USB port and how you can and cannot flash upgrade firmware via a USB port.

WARNING	If you connect or disconnect the communication cable with power applied to this module or any device on the network, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Topic	Page
Connect a 1756-EN2T Module via a USB Port	97
Flash Upgrade Firmware through a USB Port	100

Connect a 1756-EN2T Module via a USB Port

WARNING	The USB port is intended for temporary local programming purposes only and not intended for permanent connection. If you connect or disconnect the USB cable with power applied to this module or any device on the USB network, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding.

The module has a USB device port that uses a Series B receptacle. To use the USB port, you must have RSLinx 2.51 or later installed on your computer. Use a USB cable to connect your computer to the USB port. The connection lets you download programs to controllers and configure other devices, which are accessible by the module, directly from your computer.

IMPORTANT	• The USB port is designed for a temporary connection only.
	• The USB cable is not to exceed 3.0 m (9.84 ft) and must not contain hubs.
	• To maintain product certification integrity, you must use SAMTEC special-order cable, part number RSP-119350.

Set Up USB Driver

To connect your 1756-EN2T module via a USB port, you need to first set up a USB driver. To set up a USB driver, perform this procedure.
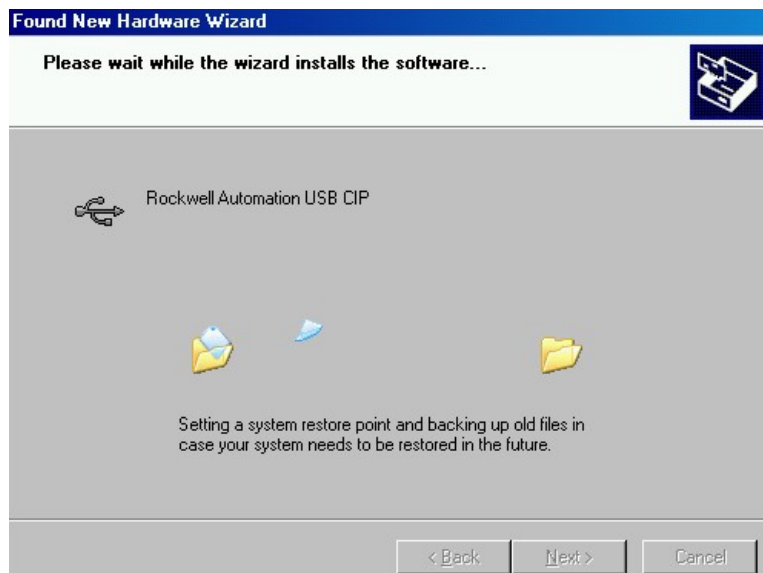
1. Connect your 1756-EN2T module via a USB port.

The RSLinx Found New Hardware Wizard dialog appears.

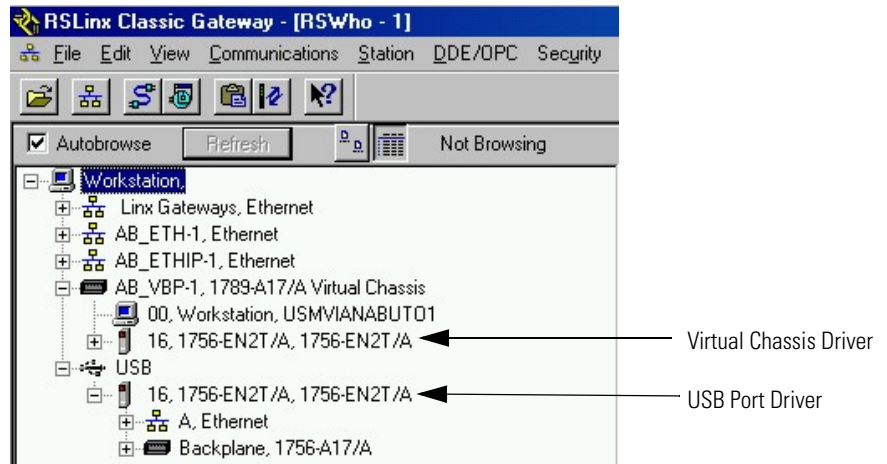**2.** Select Install the Software Automatically.

3. Click Next.

These RSLinx dialogs appear consecutively.

Found New Hardware Wizard

Please wait while the wizard installs the software...

Rockwell Automation USB CIP

Setting a system restore point and backing up old files in case your system needs to be restored in the future.

< Back   Next >   Cancel

Found New Hardware Wizard

Completing the Found New Hardware Wizard

The wizard has finished installing the software for:

Rockwell Automation USB CIP

Click Finish to close the wizard.

< Back   Finish   Cancel

4. Click Finish to set up your USB driver.

5. In RSLinx programming software, select Communications and RSWho to view your 1756-EN2T module.

Communications Station DDE/OPC

RSWho

Configure Drivers...
Configure Shortcuts...
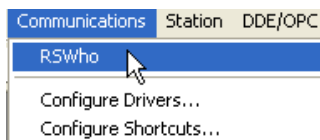
The RSLinx Workstation organizer appears.

Virtual Chassis Driver

USB Port Driver

Your 1756-EN2T module appears under two different drivers, a virtual chassis and the USB port.

Flash Upgrade Firmware through a USB Port

You may flash upgrade the firmware for **one** module through a USB port.

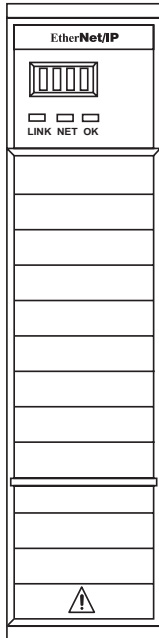| **IMPORTANT**	Do not simultaneously flash upgrade the firmware for more than one module through a USB port. If you do, one or more of the flash updates will fail in the middle of the download.

Status Indicators

Introduction

This appendix provides LED indicator descriptions for several communication modules, adapters and controllers.

Topic	Page
1756-ENBT EtherNet/IP Module Status Indicators	102
1756-EN2T EtherNet/IP Module Status Indicators	104
1769-L32E and 1769-L35E Controllers Status Indicators	106
1768-ENBT Module Status Indicators	107
1788-ENBT EtherNet/IP Daughtercard Status Indicators	109
1734-AENT EtherNet/IP POINT I/O Adapter Status Indicators	112
1794-AENT EtherNet/IP FLEX I/O Adapter Status Indicators	114

1756-ENBT EtherNet/IP Module Status Indicators

The 1756-ENBT EtherNet/IP communication module has several status indicators.

Network (NET) Status Indicator

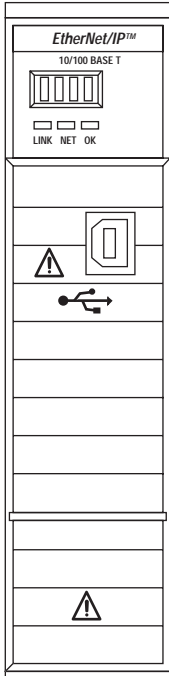| Condition	Indicates	Recommended Action
Off	Module is not powered, or does not have an IP address.	1. Verify there is chassis power 2. Verify that the module is completely inserted into the chassis and backplane. 3. Make sure the module has been configured.
Flashing green	The controller has an IP address, but no CIP connections are established.	If no connections are configured, this is normal operation. No action is required. If connections are configured, check connection originator for connection error code.
Green	Module has an IP address and at least one established connection.	Normal operation - No action is required.
Flashing red	One or more of the connections in which the module is the target has timed out.	Reestablish the connection.
Red	A duplicate IP address has been detected.	Make sure that the the IP address assigned to this module is not the same as that for any other device already on the network.

Link Status Indicator

Condition	Indicates	Recommended Action
Off	No data is being transmitted	No action is required.
Green	Module is ready to communicate.	Normal operation - No action is required.
Flashing green	Data is being transmitted.	

OK Status Indicator

Condition	Indicates	Recommended Action
Off	Module does not have 24V dc power.	1. Verify that there is chassis power. 2. Verify that the module is completely inserted into the chassis and backplane.
Flashing green	Module is not configured.	Configure the module.
Green	Module is operating correctly.	Normal operation - No action is required.
Flashing red	A duplicate IP address has been detected.	Make sure that the the IP address assigned to this module is not the same as that for any other device already on the network
	A recoverable fault has been detected.	Verify that the module was configured correctly.
Red	An unrecoverable fault has been detected.	1. Cycle power to the module. 2. If this does not clear the fault, replace the module.
Flashing red/green	Module is performing power-up self test.	Normal operation - No action is required.

1756-EN2T EtherNet/IP Module Status Indicators

The 1756-EN2T EtherNet/IP communication module has several status indicators.

Network (NET) Status Indicator

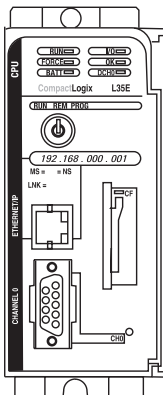| Condition	Indicates	Recommended Action
Off	Module is not powered, or does not have an IP address.	1. Verify there is chassis power 2. Verify that the module is completely inserted into the chassis and backplane. 3. Make sure the module has been configured.
Flashing green	The controller has an IP address, but no CIP connections are established.	If no connections are configured, this is normal operation. No action is required. If connections are configured, check connection originator for connection error code.
Green	Module has an IP address and at least one established connection.	Normal operation - No action is required.
Flashing red	One or more of the connections in which the module is the target has timed out.	Reestablish the connection
Red	A duplicate IP address has been detected.	Make sure that the the IP address assigned to this module is not the same as that for any other device already on the network.

Link Status Indicator

Condition	Indicates	Recommended Action
Off	No data is being transmitted	No action is required.
Green	Module is ready to communicate.	Normal operation - No action is required.
Flashing green	Data transmission in progress	

OK Status Indicator

Condition	Indicates	Recommended Action
Off	Module does not have 24V dc power.	1. Verify that there is chassis power. 2. Verify that the module is completely inserted into the chassis and backplane.
Flashing green	Module is not configured.	Configure the module.
Green	Module is operating correctly.	Normal operation - No action is required.
Flashing red	A duplicate IP address has been detected.	Make sure that the the IP address assigned to this module is not the same as that for any other device already on the network
	A recoverable fault has been detected.	Verify that the module was configured correctly.
Red	An unrecoverable fault has been detected.	1. Cycle power to the module. 2. If this does not clear the fault, replace the module.
Flashing red/green	Module is performing power-up self test.	Normal operation - No action is required.

1769-L32E and 1769-L35E Controllers Status Indicators

The 1769-L32E and 1769-L35E CompactLogix controllers have several status indicators.

Module Status (MS) Indicator

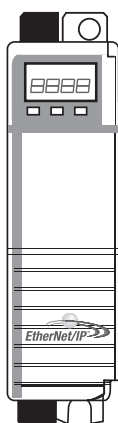| Condition	Indicates	Recommended Action
Off	The controller has no power.	Check the controller power supply.
Flashing green	The controller does not have an IP address and is operating in BOOTP mode.	Verify that the BOOTP server is running.
Green	The controller is operating correctly.	Normal operation - No action is required.
Red	The controller is holding the port in reset or the controller is faulted.	1. Clear the controller fault. 2. If the fault will not clear, replace the controller.
	The controller is performing its power-up self test.	Normal operation - No action is required.
	An unrecoverable fault has occurred.	1. Cycle power to the controller. 2. If the fault will not clear, replace the controller.
Flashing red	A duplicate IP address has been detected.	Make sure that the IP address assigned to this controller is not the same as that for any other device already on the network
	The controller firmware is being updated.	Normal operation - No action is required.

Network Status (NS) Indicator

Condition	Indicates	Recommended Action
Off	The controller does not have an IP address and is operating in BOOTP mode.	Verify that the BOOTP server is running.
Flashing green	The controller has an IP address, but no CIP connections are established.	1. If no connections are configured, this is normal, and no action required. 2. If connections are configured, check connection originator for connection error code.
Green	The controller has an IP address and CIP connections (Class 1 or Class 3) are established.	Normal operation - No action is required.
Red	A duplicate IP address has been detected.	Make sure that the IP address assigned to this module is not the same as that for any other device already on the network
Flashing red/green	The controller is performing its power-up self test.	Normal operation - No action is required.

Link Status (LNK) Indicator

Condition	Indicates	Recommended Action
Off	The port is not connected to a powered Ethernet device. The controller cannot communicate on Ethernet.	1. Verify that all Ethernet cables are connected. 2. Verify that Ethernet switch is powered.
Flashing green	The controller is performing its power-up self test.	Normal operation - No action is required.
	The controller is communicating on Ethernet.	
Green	The port is connected to a powered Ethernet device. The controller can communicate on Ethernet.	

1768-ENBT Module Status Indicators

The 1768-ENBT CompactLogix EtherNet/IP communication module has several status indicators.

Network (NET) Status Indicator

Condition	Indicates	Recommended Action
Off	Module is not powered, or does not have an IP address.	1. Verify there is chassis power. 2. Verify that the module is completely inserted into the chassis and backplane. 3. Make sure the module has been configured.
Flashing green	The controller has an IP address, but no CIP connections are established.	If no connections are configured, this is normal operation. No action is required. If connections are configured, check connection originator for connection error code.
Green	Module has an IP address and at least one established connection.	Normal operation - No action is required.
Flashing red	One or more of the connections in which the module is the target has timed out.	Reestablish the connection.
Red	A duplicate IP address has been detected.	Make sure that the the IP address assigned to this module is not the same as that for any other device already on the network.

Link Status Indicator

Condition	Indicates	Recommended Action
Off	No data is being transmitted.	No action is required.
Green	Module is ready to communicate	Normal operation - No action is required.
Flashing green	Data is being transmitted.	Module is communicating over the network.

OK Status Indicator

Condition	Indicates	Recommended Action
Off	Module does not have 5V dc power.	1. Verify there is power. 2. Verify that the module is properly installed.
Flashing Green	Module is not configured.	Configure module.
Green	Module is operating correctly.	Normal operation - No action is required.
Flashing Red	A recoverable fault has been detected.	This could be caused by an error in the configuration.
Red	An unrecoverable fault has been detected.	1. Recycle power to the module. 2. If this does not clear the fault, replace the module.
Flashing Red and Green	Module is performing power-up self test.	Normal operation - No action is required.

1788-ENBT EtherNet/IP Daughtercard Status Indicators

The 1788-ENBT EtherNet/IP communication daughtercard has several status indicators.

Module Status (MS) Indicator

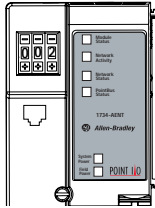| Condition	Indicates	Recommended Action
Off	The daughtercard has no power.	1. Check the host power supply. 2. Verify that the daughtercard is firmly seated in the host's slot. 3. Replace daughtercard and/or host.
Flashing green	The daughtercard does not have an IP address and is operating in BOOTP mode.	Verify that the BOOTP server is running.
Green	The daughtercard is operating correctly.	Normal operation - No action is required.
Red	The host is holding the daughtercard in reset or the host is faulted.	1. Verify that the daughtercard is firmly seated in the host's slot. 2. Clear the host's fault. 3. Replace daughtercard and/or host.
	The daughtercard is performing its normal power-up self test.	Normal operation - No action is required.
	An unrecoverable fault has occurred.	1. Cycle power to the host. 2. Replace the daughtercard and/or host.
Flashing red	A duplicate IP address has been detected.	Make sure that the IP address assigned to this module is not the same as that for any other device already on the network
	The daughtercard firmware is being updated.	Normal operation - No action is required.

Network Status (NS) Indicator

Condition	Indicates	Recommended Action
Off	The daughtercard does not have an IP address and is operating in BOOTP mode.	Verify that the BOOTP server is running.
Flashing green	The daughtercard has an IP address, but no CIP connections are established.	1. If no connections are configured, this is normal operation. No action is required. 2. If connections are configured, check connection originator for connection error code.
Green	The daughtercard has an IP address and CIP connections (Class 1 or Class 3) are established.	Normal operation - No action is required.
Red	A duplicate IP address has been detected.	Make sure that the IP address assigned to this module is not the same as that for any other device already on the network

Link Status (LNK) Indicator

Condition	Indicates	Recommended Action
Off	The daughtercard is not connected to a powered Ethernet module. The daughtercard cannot communicate on Ethernet.	Verify that all Ethernet cables are connected. Verify that Ethernet switch is powered.
Flashing green	The daughtercard is performing its normal power-up self test.	Normal operation - No action is required.
	The daughtercard is communicating on Ethernet.	
Green	The daughtercard is connected to a powered Ethernet module. The daughtercard can communicate on Ethernet.	Normal operation - No action is required.

Utilization Percent (U%) Indicator

Condition	Indicates	Recommended Action
Off	The I/O packet rate to/from this daughtercard is less than 80% of the available packet rate, and less than 80% of the 32 available I/O connections are currently in use.	Normal operation - No action is required.
Flashing green	The I/O packet rate to/from this daughtercard is at least 80% of the available packet rate (4000 packets/sec.). That is, the I/O packet rate is at least 3200 packets/sec.	
	At least 80% of the 32 available connections are currently in use. That is, from 26 to 31 I/O connections are in use.	
Green	All 32 of the daughtercard's I/O connections are currently in use.	
Flashing red/green	The daughtercard is performing its normal power-up self test.	

1734-AENT EtherNet/IP POINT I/O Adapter Status Indicators

The 1734-AENT EtherNet/IP POINT I/O adapter has several status indicators.

Module Status Indicator

Condition	Indicates	Recommended Action
Off	No power is being applied to device.	Apply power to the device.
Flashing Red/Green	LED cycle power test (module self-test) is being conducted.	Normal operation - No action is required.
Solid Green	Device is operating normally.	
Flashing Red	Firmware (NVS) is being updated and/or the address switches have changed.	1. Complete firmware update. 2. Verify address switches.
Solid Red	Self-test failure is present (checksum failure, or ramtest failure at cycle power); firmware fatal error is present.	Replace adapter.

Network Activity Indicator

Condition	Indicates	Recommended Action
Off	No link exists.	Verify network cabling, and correct, as needed.
Flashing Green/Off	I/O is being transmitted or received.	Normal operation - No action is required.
Steady Green	A link exists.	

Network Status Indicator

Condition	Indicates	Recommended Action
Off	The module has no IP address.	1. Apply power to device. 2. Verify, and correct, IP address as needed.
Flashing Green	Device has an IP address, but no CIP connections.	Normal operation - No action is required.
Solid Green	Device is online and has an IP address and CIP connections.	
Flashing Red	One or more CIP connections has timed-out.	Check for I/O module failure and controller operation, and correct, as needed.
Solid Red	Duplicate IP address has been detected.	Verify IP address setting and correct, as needed.
Flashing Red/Green	The module is performing a normal self-test, which only occurs during the cycle-power test.	Normal operation - No action is required.

POINTBus Indicator

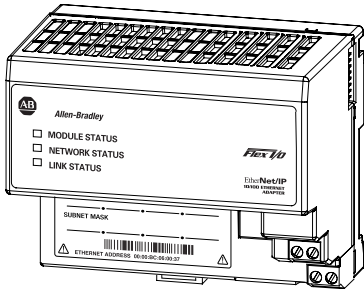| Condition	Indicates	Recommended Action
Off	Device is not powered up.	1. Apply power to device 2. Check module status indicator.
Flashing Red/Green	LED cycle power test present.	Normal operation - No action is required.
Flashing Red	• At cycle power the number of expected modules does not equal the number of modules present. • A module is missing. • Node fault (I/O connection timeout) occurred.	1. Configure chassis size. 2. Check for missing module and reinstall as needed. 3. Check for I/O module failure and correct as needed.
Solid Red	The adapter is bus off.	1. Cycle power to device. 2. If condition persists, replace device.
Flashing Green	Firmware (NVS) update is in progress.	Normal operation - No action is required.
Solid Green	Adapter is online with connections established.	

System Power Indicator

Condition	Indicates	Recommended Action
Off	Field power is off or dc-dc converter problem exists.	1. Verify that power is on, and apply power if needed. 2. Verify backplane power has not been exceeded, and correct. 3. Replace 1734-AENT module.
Green	dc-dc converter is active (5V).	None

Field Power Indicator

Condition	Indicates	Recommended Action
Off	Field power is off.	Apply field power.
Green	24V power is present.	None

1794-AENT EtherNet/IP FLEX I/O Adapter Status Indicators

The 1794-AENT EtherNet/IP FLEX I/O adapter has several status indicators.

Module Status Indicator

Condition	Indicates	Recommended Action
Off	Module does not have 24V dc power.	Make sure power is being supplied to the module.
Flashing green	Module is not configured.	Configure module.
Green	Module is operating correctly.	Normal operation - No action is required.
Flashing red	A recoverable fault has been detected.	Verify that module is configured correctly.
Red	An unrecoverable fault has been detected.	1. Recycle power to the module. 2. If this does not clear the fault, replace the module.
Flashing red/green	Module is performing normal power-up self test.	Normal operation - No action is required.

Network Status Indicator

Condition	Indicates	Recommended Action
Off	Module is not powered, or does not have an IP address.	1. Verify there is power. 2. Verify that the module is correctly wired to the power supply. 3. Make sure the module is configured.
Flashing green	Module has obtained an IP address, but has no established connections.	If no connections are configured, this is normal operation. No action is required. If connections are configured, check connection originator for connection error code.
Green	Module has an IP address and at least one established connection.	Normal operation - No action is required.
Flashing red	One or more of the connections in which the module is the target has timed out.	Reestablish the connection(s).
Flashing red/green	Module performing power-up self test.	Normal operation - No action is required.

Link Status Indicator

Condition	Indicates	Recommended Action
Off	No data is being transmitted	No action is required.
Flashing green	Module is ready to communicate.	Normal operation - No action is required.
Green	Data is being transmitted.	

Notes:

EtherNet/IP Network Connections

Introduction

EtherNet/IP communication modules use connections to manage communication. A connection is a point-to-point communication mechanism used to transfer data between a transmitter and a receiver. The EtherNet/IP communication modules use these connections:

- CIP connections for Logix-based communication

  A CIP connection transfers data from one Logix application running on one end node to a second Logix application running on another end node. A CIP connection is established over a TCP connection.

- TCP/IP connections for EtherNet/IP communication

  A single TCP connection can support multiple CIP connections.

Topic	Page
CIP Connections	117
EtherNet/IP Network Specifications	118
TCP Connections	119
Multicast Address Limit	119
Specify the Requested Packet Interval (RPI)	120

CIP Connections

Connected modules communicate more reliably than do unconnected modules.

Examples of functions supported by CIP implicit (connected) messaging include:

- Logix controller message transfer to Logix controller.
- I/O or produced/consumed tag.
- program upload.
- RSLinx DDE/OPC client.
- PanelView polling of Logix controller.

There are several types of CIP connections.

CIP Connection Type	Description
Bridged	A bridged connection is a connection that passes through the EtherNet/IP module. The end point of the connection is a module other than the EtherNet/IP module. **Example:** a connection from a controller through a 1756-ENBT to another controller.
End-node	An end-node connection is a connection whose end point is the EtherNet/IP module itself. **Example:** a connection from RSLinx to the EtherNet/IP module to set the module's IP address.
Rack-optimized	A rack-optimized connection is a connection to a rack or assembly object in the EtherNet/IP module. Data from selected I/O modules is collected and produced on one connection (the rack-optimized connection) rather than on a separate direct connection for each module.
Direct	A direct connection is a connection from a controller to a specific I/O module (as opposed to a rack-optimized connection).

The Logix5000 controller supports 250 connections, but the limit of connections ultimately resides in the communication module you use for the connection. If a message path routes through a communication module or card, the connection related to the message also counts towards the connection limit of the communication module or card.

EtherNet/IP Network Specifications

These are the EtherNet/IP network specifications.

Catalog Number	Connections		CIP Unconnected Messages (backplane + Ethernet)	Packet Rates (packets/ second)		SNMP Support (password required)	Media Support	
	TCP	CIP		I/O	HMI/MSG		Twisted Pair	Fiber
1756-ENBT	64	128[1]	128bp+128enet	5000	900	Yes	Yes	No
1756-EN2T	128	256[1]	128bp+128enet	10,000	3900	Yes	Yes	No
1768-ENBT	64	128[1]	128bp+128enet	5000	960	Yes	Yes	No
1769-L3x	64	32[1]	32bp+32enet	4000	760	Yes	Yes	No
1734-AENT	64	20	NA	5000	NA	No	Yes	No
1794-AENT	64	64	NA	9500	NA	Yes	Yes	No
2x-COMM-E	30	16	16	400	50	No	Yes	No
1756-EWEB	64	128[1]	128bp+128enet	NA	900	Yes	Yes	No
1768-EWEB	64	128[1]	128bp+128enet	NA	960	Yes	Yes	No

[1] CIP connections for these devices can be used for all explicit or all implicit applications.
Example: A 1756-ENBT has a total of 128 CIP connections and can be used for any combination of connections.

EtherNet/IP Network Specifications

Catalog Number	Produced/Consumed Tags		Socket Services	Speed Duplex (Half/Full)	Duplicate IP Detection (starting revision)
	Max Number of Tags	Unicast Available			
1756-ENBT	32	Version 16	No	10/100	Revision 3.3
1756-EN2T	32	Version 16	No	10/100	Revision 1.*x*
1768-ENBT	32	Version 16	No	10/100	Revision 1.*x*
1769-L3*x*	32	Version 16	No	10/100	Revision 15
1734-AENT	NA	NA	No	10/100	Revision 2.1
1794-AENT	NA	NA	No	10/100	Revision 3.*x*
2*x*-COMM-E	NA	NA	No	10/100	Revision 1.1
1756-EWEB	NA	NA	Yes	10/100	Revision 2.2
1768-EWEB	NA	NA	Yes	10/100	Revision 1.*x*

> **IMPORTANT** Non-CIP communications require 1756-EWEB or 1768-EWEB sockets. See the EtherNet/IP Web Server User Manual, publication ENET-UM527D.

TCP Connections

An EtherNet/IP module uses one TCP connection for each IP address to which the EtherNet/IP module is connected. Multiple CIP connections can go through a single TCP connection. Examples of TCP connections include:

- HMI (human-machine interface) to a controller that supports EtherNet/IP communications.
- Logix MSG instruction to a controller or workstation.
- OPC or DDE accessing a controller.
- I/O data.
- produced or consumed tags.

The 1756-ENBT, 1788-ENBT, and 1794-AENT modules each support 64 TCP connections.

Multicast Address Limit

Connections that produce data over an Ethernet network use multicast addresses. EtherNet/IP modules support a maximum of 32 unique multicast addresses. The actual address (such as 239.192.22.121) is determined by the EtherNet/IP module.

Example 1: An Ethernet adapter that produces data uses a unique multicast address for each I/O connection.

Example 2: A Logix controller that produces tags uses a unique multicast address for each produced tag.

The multicast address limit is independent of the connection limit for a module. Not all connections require a multicast address. And for produced and consumed tags, one produced tag requires one multicast address and one connection for each consumer. For multiple consumers, the one multicast address would use multiple connections.

Specify the Requested Packet Interval (RPI)

The RPI is the update rate specified for a particular piece of data on the network. The RPI can be specified for an entire rack (using a rack-optimized connection) or for a particular module (using a direct connection).

When adding a module to the I/O configuration of a controller, you must configure the RPI. This value specifies how often to produce the data for that module. For example, if you specify an RPI of 50 ms, every 50 ms the I/O module sends its data to the controller or that the controller sends its data to the I/O module.

RPIs are used only for implicit connections, such as produced/consumed tags and I/O. For example, a local EtherNet/IP communication module does not require an RPI because it does not produce data for the system but acts only as a bridge to remote modules.

Set the RPI only as fast as needed by the application. The RPI also determines the number of packets per second that the module will produce on a connection.

Each module has a limit on the total number of implicit packets per second. The total includes the sum of sent and received implicit packets. The packet rate for implicit messages is for implicit only, and neither matches nor includes the explicit packet rate.

EtherNet/IP Network Overview

Introduction

This appendix defines some basic Ethernet network concepts and how the EtherNet/IP protocol is used for control.

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Ethernet Protocols

On the most basic level, Ethernet is a wire or cable that connects computers and peripheral modules so that they can communicate. The actual wire used for the network is referred to as the network medium. Beyond the physical medium, all Ethernet networks support protocols that provide sophisticated data transfer and network management capability.

Protocol Descriptions

Protocol	Description
Transmission control protocol/internet protocol (TCP/IP)	TCP/IP is a transport-layer protocol (TCP) and a network-layer protocol (IP) commonly used in business environments for communication within networks and across internetworks. The EtherNet/IP communication modules use TCP/IP for explicit messaging, that is, messages in which time is not a critical factor, such as uploading or downloading programs.
User datagram protocol/Internet protocol (UDP/IP)	UDP is a much simpler transport protocol. It is connectionless and provides a very simple capability to send datagrams between two modules. UDP is used by applications that implement their own handshaking between modules and only want a minimal transport service. UDP is smaller, simpler, and faster than TCP and can operate in unicast, multicast, or broadcast mode. The EtherNet/IP communication modules use UDP/IP for real time I/O messaging.
CIP	CIP applies a common application layer over Ethernet by encapsulating messages in TCP/UDP/IP. This common application layer is the control and information protocol (CIP), which provides interoperability and interchangeability of industrial automation and control modules on Ethernet. EtherNet/IP supports both real-time I/O (implicit messaging) and explicit messaging. See the EtherNet/IP Performance and Application Guide, publication ENET-AP001, for more information on EtherNet/IP.
Simple network management protocol (SNMP)	SNMP is a standard for network management within TCP/IP environments. This enables client applications monitor and manage network information on host computers and gateways. This protocol is password-protected. SNMP uses a distributed architecture consisting of management systems and agents. Data is passed from SNMP agents, which are hardware and/or software processes reporting activity in each network module (switch, router or bridge) to the workstation console used to oversee the network. The agents return information contained in a MIB (management information base), which is a data structure that defines what is obtainable from the module and what can be controlled (turned off or on).
Internet Group Management protocol (IGMP) snooping	IGMP snooping enables switches to route multicast traffic by distributing each packet only to the ports that need to receive it. Many switches support this feature. However, most of these switches require a router be present in the system for IGMP snooping to work. If your control system is a stand-alone network or is required to continue performing if the router is out of service, make sure the switch you are using supports IGMP snooping without a router present. This feature is highly recommended for EtherNet/IP systems the control I/O.

Use of the Common Industrial Protocol (CIP)

The EtherNet/IP communication modules use the Common Industrial Protocol (CIP). CIP is the application layer protocol specified for EtherNet/IP, the Ethernet Industrial Protocol, as well as for ControlNet and DeviceNet.

CIP is a message-based protocol that implements a relative path to send a message from the producing module in a system to the consuming modules.

The producing module contains the path information that steers the message along the proper route to reach its consumers. Since the producing module holds this information, other modules along the path simply pass this information; they do not need to store it. This has two significant benefits.

- You do not need to configure routing tables in the bridging module, which greatly simplifies maintenance and module replacement.

- You maintain full control over the route taken by each message, which enables you to select alternative paths for the same end module.

CIP uses the producer/consumer networking model instead of a source/destination (master/slave) model. The producer/consumer model reduces network traffic and increases speed of transmission.

In traditional I/O systems, controllers poll input modules to obtain their input status. In the CIP system, digital input modules are not polled by a controller. Instead, they produce (multicast) their data either upon a change of state (COS) or periodically. The frequency of update depends upon the options chosen during configuration and where on the network the input module resides. The input module, therefore, is a producer of input data and the controller is a consumer of the data.

The controller can also produce data for other controllers to consume. The produced and consumed data is accessible by multiple controllers over the Logix backplane and over the EtherNet/IP network. This data exchange conforms to the producer/consumer model.

Configuration Requirements

Before you can use an EtherNet/IP module, you must configure its IP address, gateway address, and subnet mask.

IP Address

The IP address identifies each node on the IP network (or system of connected networks). Each TCP/IP node on a network must have a unique IP address.

> **IMPORTANT**   Contact your network administrator or the Network Information Center for a unique fixed IP address to assign to the EtherNet/IP module.

The IP address is 32 bits long and has a network ID part and a host ID part. Because networks vary in size, there are four types of networks.

Network Type	For
Class A	Large networks with many devices
Class B	Medium-sized networks
Class C	Small networks (fewer than 256 devices)
Class D	Multicast addresses

The network class determines how an IP address is formatted.

```
          0                8              16        24              31
Class A   0 |  network (7 bits)   |         local address (24 bits)       |

          0                8              16        24              31
Class B   1 | 0 |   network (14 bits)   |       local address (16 bits)    |

          0                8              16        24              31
Class C   1 | 1 | 0 |    network (21 bits)         |   local address (8 bits) |

          0                8              16        24              31
Class D   1 | 1 | 0 | 1 |       multicast address (28 bits)              |
```

Each node on the same physical network must have an IP address of the same class and must have the same network ID. Each node on the same network must have a different local address (host ID), thus giving it a unique IP address.

IP addresses are written as four-decimal integers (0-255) separated by periods where each integer gives the value of one byte of the IP address.

For example, the 32-bit IP address:

10000010 00000000 00000000 00000001 is written as 130.0.0.1.

You can distinguish the class of an IP address from the first integer in its IP address as follows.

Class	Leftmost Bits	Start Address	Finish Address
A	0*xxx*	0.0.0.	127.255.255.255
B	10*xx*	128.0.0.0	191.255.255.255
C	110*x*	192.0.0.0	223.255.255.255
D	1110	224.0.0.0	239.255.255.255

Gateways

A gateway connects individual physical networks into a system of networks. When a node needs to communicate with a node on another network, a gateway transfers the data between the two networks. The following figure shows gateway G connecting Network 1 with Network 2.
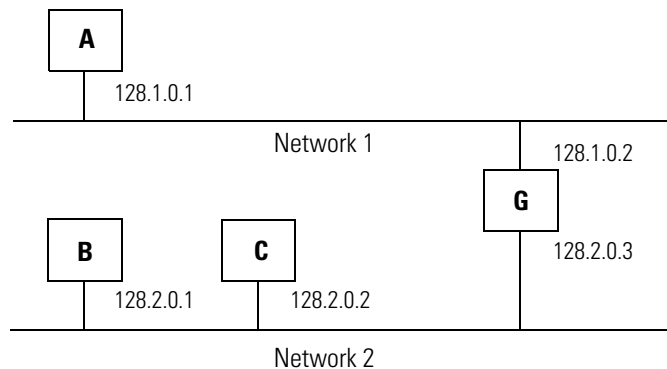
When host B with IP address 128.2.0.1 communicates with host C, it knows from C's IP address that C is on the same network. In an Ethernet environment, B can then resolve C's IP address to a MAC address and communicate with C directly.

When host B communicates with host A, it knows from A's IP address that A is on another network (the network IDs are different). To send data to A, B must have the IP address of the gateway connecting the two networks. In this example, the gateway's IP address on Network 2 is 128.2.0.3.

The gateway has two IP addresses (128.1.0.2 and 128.2.0.3). Network 1 hosts must use the first IP address, and Network 2 hosts must use

the second IP address. To be usable, a host's gateway IP address must match its own net ID.

Subnet Mask

Subnet addressing is an extension of the IP address scheme that enables a site to use a single net ID for multiple physical networks. Routing outside of the site continues by dividing the IP address into a net ID and a host ID via the class. Inside a site, the subnet mask is used to redivide the IP address into a custom net ID portion and host ID portion.

Take Network 2 (a Class B network) in the previous example and add another physical network. Selecting the following subnet mask would add two additional net ID bits allowing for four physical networks.

    11111111 11111111 11000000 00000000 = 255.255.192.0

Two bits of the Class B host ID have been used to extend the net ID. Each unique combination of bits in the part of the host ID where subnet mask bits are 1 specifies a different physical network.

New Configuration
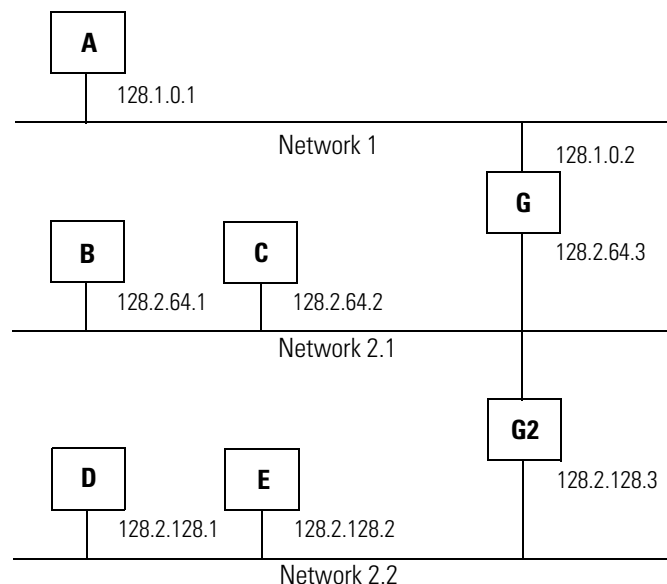
A second network with Hosts D and E has been added. Gateway G2 connects Network 2.1 with Network 2.2. Hosts D and E will use Gateway G2 to communicate with hosts not on Network 2.2. Hosts B and C will use Gateway G to communicate with hosts not on Network 2.1. When B is communicating with D, G (the configured Gateway for B) will route the data from B to D through G2.

Manual Configuration on an Ethernet Switch

The EtherNet/IP modules support these Ethernet settings.

- 10 MBps half-duplex or full-duplex
- 100 MBps half-duplex or full-duplex

Mode selection can be automatic, based on the IEEE 802.3 autonegotiation protocol. Or, with RSLogix 5000 programming software version 12 and later, you can manually set the communication rate and duplex mode of the communication module and the switch port that is connected to the module. If you manually set the communication rate and duplex mode, the settings of the communication module and the switch port must match.

In most cases, autonegotiation results in proper operation between a switch port and an EtherNet/IP module. However, when troubleshooting a network, you can force duplex and speed settings first at the EtherNet/IP module and then at the switch port to eliminate system variables.

Change Ports on an Ethernet Switch

If you reconnect the EtherNet/IP module from one port to another, regardless of whether the new port is on the same or a different switch (or a hub), perform this procedure.

1. Disconnect the cable from the port to which the EtherNet/IP module is currently connected.

2. Wait until the EtherNet/IP module Link Status LED is off.

3. Connect the cable to the new port.

This procedure restarts the autonegotiation process at the EtherNet/IP module side. Another option is to restart the EtherNet/IP module itself.

Additional Resources

For more information about TCP/IP and Ethernet technologies, see these publications.

Publication Title	ISBN Number
Internetworking with TCP/IP Volume 1: Protocols and Architecture, 2nd ed. by Douglas E. Comer	ISBN 0-13-216987-8
The Ethernet Management Guide – Keeping The Link	ISBN 0-07-046320-4
An Introduction to TCP/IP	ISBN 3-540-96651-X
Computer Networks by Andrew S. Tanenbaum	ISBN 0-13-162959-X

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